DOCUMENT RESUME

ED 082 157 CS 000 750

AUTHOR	Wark, David M., Ed.
TITLE	College and Adult Reading, III and IV; Third and Fourth Yearbooks.
INSTITUTION	North Central Reading Association, St. Paul, Minn.
PUB DATE	65
NOTE	199p.; Report of the papers presented at the Annual Meetings of the North Central Reading Assn. (Univ. of Michigan, 1963 and Univ. of Notre Dame, 1964); See related documents CS000748-749 and CS000751-752
AVAILABLE FROM	David M. Wark, Reading and Study Skills Center, Student Counseling Bureau, Univ. of Minnesota, Minneapolis, Minn. 55455 ($2.50)
EDRS PRICE	MF-$0.65 HC-$6.58
DESCRIPTORS	Adult Reading Programs; Cloze Procedure; College Instruction; Composition Skills (Literary); Conference Reports; Developmental Reading; *Discrimination Learning; Eye Fixations; *Information Theory; Programed Instruction; Reading Improvement; Reading Processes; *Reading Research; *Reading Skills; Study Skills; Visual Discrimination; *Visual Perception

ABSTRACT

This single volume constitutes the third and fourth yearbooks of the North Central Reading Association and consists of most of the papers presented at the 1963 and 1964 annual meetings of the NCRA. The papers are grouped into four sections: Discrimination, Information Theory, Skill Therapy and Skill Training, and The Visual Process. Among the topics covered in the seventeen papers are the cloze procedure, research reviews of skill therapy and visual discrimination, a college composition program, the SQ3R system, and reading as information processing. (TO)

ED 082157

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

COLLEGE AND ADULT READING

III and IV

THE
THIRD AND FOURTH
YEARBOOKS
OF THE

NORTH CENTRAL READING ASSOCIATION

Edited by

David M. Wark
Reading and Study Skills Center
Student Counseling Bureau
University of Minnesota

1965

CS 000 750

FILMED FROM BEST AVAILABLE COPY

PREFACE

This single volume constitutes the third and fourth yearbooks of the North Central Reading Association. The papers printed here were presented either at the University of Michigan in 1963, or at the University of Notre Dame in 1964. A date following the author's name on the table of contents tells which year. Donald E. P. Smith has our thanks and admiration for hosting the Michigan meeting, and planning both programs.

Unfortunately, all of the papers are not printed in this yearbook. Two reports by Alton Raygor, of the University of Minnesota, will be published through other sources. Another by Carl Semmelroth was an extensive auto-instructional program in experimental format. Stuart Margules, of Basic Systems, Incorporated, presented a copyright magnetic tape recording, which, of course, we could not publish. Donald and Judy E. P. Smith presented parts of an experimental version of a program to teach basic language skills. Both the Margules tape and the Smiths' final program have recently been cited as examples of excellence in programmed instruction.

I have taken several liberties in combining papers into four Sections. The reader will note that papers presented at different years are grouped together. I tried to juxtapose them either to show historical development, or to contrast differing points of view. The papers on discrimination, for example, seem, in retrospect, to converge to Smith's paper on learning to read. Section 4 concerning the visual process, on the other hand, offers somewhat diverging points of view. Stanford Taylor summarizes a great deal of prior literature on the study of eye movements. At the same meeting, Smith and Semmelroth present evidence of an entirely new phenomenon, micro-movements. The largest section is a collection of papers having to do with study skills. As Richard Stevens points out in his critique, here you will find both an attack on old formulations and an embryonic "new look" at recurring problems.

Combining two years' papers in one large volume is a particularly valuable technique when, as in this case, they report on going research. The reader gets a very dramatic feeling of watching the scientific Zeitgeist evolving, longitudinally. The feeling is, at least for me, vastly different from that produced by the typical yearbook, with its often cross-sectional or retrospective coverage.

To the people who researched and wrote, our thanks for new light on the still murky old problems of reading. Most especially, thanks to Don Smith for focusing that light so sharply.

Before closing, I would like to publicly acknowledge my private debt to the five young ladies whose skills were made available by the Student Counseling Bureau. Karla Nyman, Marky Peterson, Katherine Steele and Paulette Wank labored most patiently preparing the rough drafts for this Yearbook. Miss Marjorie Hoines did a truly impressive job preparing the final copy. Their efforts made my job much easier. To these gracious charmers, my deep gratitude. To you, gentle reader and sharp-eyed reviewer, my apologies for whatever errors I alone may have let slip through to annoy you.

D.M. W.

TABLE OF CONTENTS

1. Discrimination

Review of Research: Visual Discrimination
Frank Greene (1963) 1

A Self-Instruction Program for Discrimination Training
R. Robert Geake (1963) 20

Learning to Read as a Discrimination Process
Donald E. P. Smith (1964) 28

Critique of "Learning to Read as a Discrimination Process"
Philip Clark (1964) 52

2. Information Theory

Closure and the Cloze Procedure
Earl F. Rankin (1963) 54

Reading as Information Processing
Carl Semmelroth (1963) 85

Reading Comprehension as Information Processing
Philip Clark (1963) 96

3. Skill Therapy and Skill Training

Review of Research: Skill Therapy
Daniel G. Sayles (1963) 106

Skill Therapy: A treatment Rationale for Educators
Donald E. P. Smith (1963) 115

Technique: The Intensive Workshop
Olof Karlstrom (1963) 124

Task Analysis - The Crux of Programming
Dale M. Brethower (1964) 133

Structure of a Program for College Composition
Hal R. Weidner (1964) 141

Finding Answers by Reading
Nancy B. Davis (1964) 152

Survey Q3R: System or Superstition?
David M. Wark (1964) 161

The "New Look" in Skills Training:
A Critique
Richard Stevens (1964) 171

4. The Visual Process

Visual Motility
Stanford Taylor (1963) 174

Micro-Movements During Apparent Fixation in Reading
Donald E. P. Smith and Carl Semmelroth (1963) 188

REVIEW OF RESEARCH: VISUAL DISCRIMINATION

Frank Greene
University of Michigan

Perception is the "black box" of the reading process. Therein should lie answers to many of the reading specialist's pressing problems. But no clear theory of perception exists. The best he can do is to review the vast array of data and speculation and try to discover some of its order.

The purpose of this review is to present selected definitions and findings, to erect a rough scaffold from which the reading specialist can view the perceiver, the perceived, and possibly, the viewer himself.

I. Perception versus Discrimination

A. The Problem

The observer (O) responds (R) to a stimulus (S), some part of the printed page. Which part of R is attributable to properties of S, which to the interwoven variables effecting O, and which to the kind of R required? This very complex question might be attacked by defining some terms.

Perception is defined as the processing of information within a closed system. Given the existence of some S as input, the processing consists of the organization (identification, recognition, categorization) of the S and its integration with other active elements in the system in such a way that an output occurs, i.e., some potentially identifiable behavior, R. This definition ties the processing to the public world at both ends: there must be some S and some R, the existence of which are potentially observable. The processing itself must be inferred.

Discrimination. When a particular R occurs consistently in the presence of a particular S or class of S but not in the presence of another S or classes of S's, we may infer that a discrimination has occurred. Since the S and the R are both observable phenomena, we need not speculate about mediating processes. Such speculation occurs when the apparend, literal S is responded to in variable ways.

Veridicality of perception. The physical characteristics of S can usually be described. It might be called a literal S. To some investigators, perception is defined as some R to a given literal S, thus "literal perception." But the more common event is that called selective or "schematic" perception. In achieving his purposes, O tends to respond to the literal S in unpredictable ways. His description of the S in such cases indicates a distortion of the literal S.

Literal perceptions are adequate and exact. The agreement between the perceptions of different O's is impressive. We do all live in the same world. On the other hand, schematic perceptions are selective, creative, fleeting, inexact, generalized. The lack of correspondence between perceptions is very impressive. We do each live in our separate and unique worlds.

How much literalness is adaptive is often of interest to teachers of reading. In spelling we wish the perceptions to be very literal: the form of letters and their order must be exact. But with regard to comprehension, it is not important what the word is, but only that the schematic perceptions are in reasonable agreement with the literal S, i.e., did O get the message? E. J. Gibson (5) has suggested two different ways an O might identify S input. One might run through a property-list procedure of subjecting each S to a series of tests, each determining some S property of heuristic value. Or one might subject S input to a normalizing procedure and then attempt some sort of template matching. It seems likely that both methods are used with every S input identification. For any discrimination to occur there must be a template to match against. When literal perception is required, a thorough checking of all the critical features built into the template occurs. When schematic perception is acceptable, only a rough fit (checking fewer of the possible features) is needed. However, the very existence and precision of any template is limited by the accurate location and identification of critical features of S during the learning of the templates. The precision of the learned template limits literal perception, even though the actual precision used during matching is determined by selectivity considerations, i.e., amount of distortion required by O to fulfill his purpose.

B. Solutions

Perceptual theorizing tends to bridge the two views of how the world is constructed: percepts are accurate reflections of a common world we share vs. percepts are highly individualistic. The task is to tie together the public and exact world of all people (literal) and the private and selective world of each person (schematic). I will discuss two notable efforts by psychologists to provide some tie.

Hebb (9) offers a physiological model. In the newly developing nervous system, the spread of excitation is random at first. After repeated receptor stimulation, neurons become organized in functional units (cell assemblies) which can keep an input active after the S has been removed. With further stimulation, these units increase in stability. As sensory experience continues, these units combine into more elaborate temporal organizations (phase sequences). The role of experience is to establish percepts or "templates" by eliciting these stable organizations in the presence of particular S arrays. Thus as R to a particular S becomes possible via the mediation of these cell assemblies and phase sequences.

Complex perceptions will depend on higher order organizations, evolved from the more literal units through a process called condensation. "Over a series of trials trace activity leads to perservative consolidation. Through repeated interference a series of trials also leads to fractionation (splitting off). In this way condensation, the development of a smaller more efficient trace, occurs." (11) The ability to perceive schematically arises out of stimulation by critical features of the S array. Necessary and sufficient features consolidate over time while non-critical features cancel (fractionate) out.

Attneave (1) applies the language of information theory to the analysis of perception. He views perception as information handling, where most of the information is redundant (non-critical) areas of homogeneous color, persistent direction or slope, symmetry of design, uniform texture gradient. The individual letters in a "sight word" for example would be seen as largely redundant. A highly "predictable" word in a given context is also redundant: it adds little information to the message. During perception, redundant aspects of S are overlooked, i.e., not encoded. The resulting encoded message is more economical from an information point of view than the S array from which it came. That is to say, schematic perception is more efficient than literal, for, by basing a response on only the critical (non-redundant) features, one is not required to attend to the redundant ones. When a literal perception is required, complete and exact accounting must be made of all the S features, redundant or not. Note, however, the problem of the sophisticated O. After the critical features have been located (consolidated, chunked), a sufficient match between template and S occurs on the basis of those features alone. It may then be difficult to attend to even non-redundant features (cf. later discussion of S incongruity). Attneave's use of concepts from information theory is a useful strategy. One more notation might be usefully adopted. Noise may be defined as anything which interferes with clear reception of the message. In a visual context, noise would be analogous to clutter, (to coin a term), i.e., the presence of non-critical, non-redundant visual stimulation.

The term gating refers to the shutting out of irrelevant stimuli, e.g., lack of awareness of street noises outside the window or the pressure of the chair. From the point of view of information theory, gating might be interpreted as follows: irrelevant stimuli are "chunked", thereby providing a unit with the critical features of the S array standing out as a figure on a ground of irrelevant features. A template can encompass any features of the S array, and most likely a range of background stimulation is indeed a part of every template.

Distortion of what might be considered ground rather than figure in any S array will prevent template matching just as much as will figure distortion.

Summary. The essential problem in describing how we perceive is to specify conditions which lead to literal or to schematic interpretations of S. Purpose or set, template precision and redundancy have been implicated. Section II will concern the development of literal perception.

II. Literal Perceptions

The Stimulus. J. J. Gibson (6) postulates some "anchoring" characteristics for literal perceptions. To perceive is to differentiate (discriminate), and a differentiation implies a difference. For example, "d" is different from "a" because it has a tail and not because the reader knows more or fewer words that begin with either letter. Similarly "a" is not different from "a" if the writer had done his job properly, and no enrichment by past experience or inspired guessing will help to make them different. (2) Considering the poor visual apparatus with which humans operate, and the multitude of conditions under which different O's can experience the same S, it is indeed remarkable how closely most perceptions match the "real world".

Stevens (19) defines S as follows: "An adequate S to a visual perception is a spatial and temporal pattern of radiant energy impinging on the retina." Furthermore, Gibson (6) points out that "It is not true to say that what happens on the retina is a succession of fragmentary images. There occurs a succession of overlapping images 180° wide, only the centers of which are registered by the nervous system in fine detail." (See also (17)).

If these statements are true, it is clear that the literal world cannot be perceived all at once. A single fixation yields only a momentary visual field. To see more takes time. Successive retinal images are not distinct pictures like comic strip frames. They overlap so that each image is a transposition of the just preceding image.

It might be predicted, then, that if a person were to read rapidly enough, the order in which the material is scanned might become immaterial. We must "... assume each fixation is followed by a primary memory which fades very slowly. Each segment of each image is fitted to every other by the compensation mechanism. The result would be a panoramic world which will have faded least in memory at the point of regard and most at points longest ago regarded. The fading would not be a decrease in clarity (like that from center to periphery of visual field), but only a decrease in reportability or that quality of experience that goes with recency." (J. J. Gibson, (6)).

Learning to Discriminate. Perceptual development is illustrated by observing a series of responses by an infant over time; at first to stimuli grossly similar to the focal S and later only to those closely similar. Any round, facelike object will satisfy a very young child, but soon the babe demands a real face, a real, smiling face, the real, smiling face of his very own mother.

Redundancy. Wohlwill (21) expresses this developmental progression in terms of S redundancy and increasing age. The younger the child, the more the need for complete and simple (highly redundant) patterns for successful discrimination. Younger children show a preference for an uncluttered S array. That is, prior to the learning of some control techniques for non-specific input from various sensory modalities, all children behave in relatively non-specific ways. Young children do, however, show a marked tendency to follow along continuous linear paths in their perception of shape and to focus on the general outline of the figure rather than on internal detail. This tendency to go from line to line and curve to curve rather than to follow some more complex sequential pattern may well persist as a basic scanning procedure even in well developed visual search. The low potency of form (e.g., the "shape" of an object) when contrasted with the spatially more redundant cues, such as color or solid (filled in) vs. outline, shows this same developmental change.

Space. The need for two-dimensional border cues in learning to discriminate b, d, p, q, and other such similar letters is clearly supported in the developmental studies of Witkin (20). This need for a non-symmetric reference frame has direct implications for the teaching of letter formation, if not for the reading task where the other letters and words provide some frame of reference. If the only reference frame the child has is the outline of the paper itself, it is little wonder that he wanders about in forming letters and in stringing them into words.

Chunking. With a given S array, the problem of how to handle the information available may well be determined on the basis of S complexity. Many studies of perceptual organization of complex S arrays have shown that, up to some quite limited number of components, O attends to each. When S complexity becomes greater, O tends to unitize (chunk) by categorizing the components. That is, he responds to grosser patterns of clues, the commonest features (15, 16).

The perceived S complexity and consequent attempt to handle the overload may result in what we usually call closure. When closure occurs, the state of clutter can be dramatically reduced with the emergence of a simpler, chunked pattern.

"Processing" time. It may well turn out that the difference between good and poor readers is not in visual acuity or number and duration of fixations but in the amount of time necessary to "process" or categorize visual stimuli (7). The concept of differential processing time may be related to the notion about directionality during reading. Given a rather slow processing time, a sequential moderate pattern might lead to maximum comprehension. With fast processing time combined with a very fast rate, the importance of coverage pattern should be reduced. All of the information should still be recent enough to be categorized "reportable."

Saccadic movements. Contrary to many early statements, it appears quite clear that saccadic movements are not random or "thrown" (as implied by the word, saccadic), but are rather more like guided missile movements, with a predetermined goal and in-flight control. "Studies of the sequence of eye fixations during search show that the eyes usually move ballistically from one quite clearly defined object or element in the display to another such element, i.e., the paths of the movement and the stopping point are determined before the movement begins. For this to occur the object of each succeeding fixation must be perceived peripherally before it is perceived foveally" (18). The implication here is that the contribution of peripheral vision to the smoothness of saccadic movements during search of the S array (e.g., printed plate) may be of much more importance than one would suspect from searching the literature. Burian (14) reported on the effect of peripheral stimuli on fusional movements. The peripheral retinal areas were reported to exert such powerful fusional control that it would affect the relative position of the eyes even to the extent of losing central vision! Recalling Gibson's conclusion that there occurs a succession of overlapping images with clear centers, peripheral stimulation takes on a new role of guiding the mechanism by which each successive image is fitted into the total panoramic memory of just-preceding fixations.

Summary. Time for space awareness, development of perceptual constancies, the guiding of the clearest (foveal) vision by peripherally acquired information, the level of random neuron firing at the time of template formation, and individual "processing" time requirements are all considered as necessary for the emergence of literal perception. The efficiency of each of these processes is seen as setting the limits for the precision with which a template can be formed. No discrimination can be more accurate than available template precision.

III. Schematic Perceptions

Literal perceptions arise from accurate, distinctive-feature checking. The resulting patterns of features may then be conceived as templates to which incoming patterns of stimulation can be matched. Yet, in many reading situations, the S itself may be ambiguous (look-alike words, etc.), or be ambiguous for certain O's (where private conditions such as high emotionality may grossly influence the perception of a word). A common expression of this problem is the continuing concern for sensitivity to context. Some words cannot be responded to without contextual confirmation, i.e., selective or schematic perception is necessary. In other words, literal perception would be insufficient to satisfy a set.

A. Template Precision

The development of schematic perceptions must rest on literal experience. Given adequate templates, their use in schematic perception is a function of their precision and their availability.

Template precision includes the maximum specificity of which the template is capable and the amount of inexactness allowable by the immediate task or set. Premature chunking of S would be expected to lead to an inaccurate model simply because it is likely to be incomplete in its inclusion of critical features of the total S array. Children who look too quickly at a word tend not to learn it well enough to be able to discriminate it successfully later. There is also a problem that what may look like template inaccuracy may be, in fact, simply looseness in matching the template to the S. An example of this would be the apparent intolerance we have for stimuli which are not congruent with our past experiences. The Bruner (13) experiments with cards having red spades and black hearts provides an example of O's inability to recognize the incongruity of some stimuli. Another condition that looks like low template accuracy may be just the opposite. If the template is so exact that an exceptionally large number of features of the S background array assume a role in the figure, it may be nearly impossible to replicate the original conditions sufficiently that matching can ever occur. This condition might be present in the inability to recognize a sight word because this presentation lacks the smudge in the lower corner of the card, or because the teacher left the room and in all previous contacts with the word, she was somewhere in the background of the page. Even assuming a potentially exact template, sometimes past experience or current states can influence the apparent allowance in a template.

B. Template Availability

Some amount of perceptual processing (the locating in storage of a template potentially matchable to the current S) must occur before experience can exert any influence on the template (cf., 22). It is postulated that, given an available template, the effect of experience will be reflected in either sharpening or leveling the accuracy with which the template might be used. It may be that motivation and experience act rather like a monitor which tunes the receiving system to narrow or broad template selectivity. With high selectivity O would have high sensitivity to a limited S, i.e., an exact and potent template. With broad selectivity, O would have low sensitivity to a wide range of S features, i.e., a number of templates might match the input.

Assuming the existence of a template, there still arise conditions under which O seems unable to perform in the manner one might expect. Of such conditions, Semmelroth (16) states: "....the size of the effective visual peripheral field may be of importance in tasks which require the processing of visual information from an uncertain field. If this is so, then other variables may be important in such tasks besides those pertaining to the content and structure of the (foveal) visual field." These other variables might include stress, set, emotionality, or other factors which, through their influence on the size of the visual field, might affect the relative potency of other stimuli (clutter) in the field.

Frank Greene

Reading can be classed as a visual task with some field uncertainty. If needs influence the relative dominance of peripheral vs. foveal control, erratic saccadic movements in "tense" readers might be explained by influencing the sharpness or levelness of a template. Another way experience might affect the perceptual process is by simply making it impossible to locate any appropriate template. Increased peripheral sensitivity would make it much harder to get a clear look of sufficient duration at any point of regard before the eyes were moved. Even if the eyes were controlled in rate sufficiently to allow a clear look, with high peripheral sensitivity it would be very difficult to achieve adequate fusion if the data from the Burian studies (4) is correct.

What are the determiners of foveal vs. peripheral dominance? Perhaps specific purposes, a set to find "X", act to increase foveal dominance, thus reducing excess movements and allowing rapid, accurate perception. On the other hand, emotionality (non-specific tension) in a reading situation may lead to increased peripheral dominance, with resulting erratic movements. If the tension of emotionality is non-specific, its action would be to increase the "random" or task irrelevant inputs. Thus, no "appropriate" template could be matched.

The recent findings of Kaplan (11) also suggest another cause of template unavailability. The consolidation of learning into a usable form (i.e., retrievable from storage) apparently takes some time. It is as if the necessary template is involved with some perseverative activity which firmly sets the template in memory. Since it is already in service, it is not available for use now. It might, however, be available at a later time.

Summary. Schematic perceptions appear to result when set requirements fail to match the available stimuli. Template precision, template availability, and conditions of emotionality which influence the matching process appear to be the most relevant variables.

IV. Training

Set. Discrimination is a function of the perceiver's set or readiness to respond. Keislar (12) reported an attempt to shape learning sets in reading. Using passages with two kinds of information in them, he had one group (6th and 7th graders) test their comprehension after each selection using tests that only required one type of information. The other group used the same procedure except that their tests required only the other type of information. After twenty training passages both groups were given more passages which had tests covering both types of information. The type of information required for the training tests was the type of information best responded to on the post-training tests. The training tests had defined what was worth learning, which is to say, only necessary discriminations will be made.

Kossov (13) designed a study to bring out the essential features of a perceived object. After manipulating various components of the object he concluded that the transformation of a feature into a "dominant component" is better done by variations of the essential feature than by varying any or all of the non-essential ones (i.e., only necessary discriminations will be made).

Noise. Many of the problems in training better reading appear to stem from failure to observe these principles: a) only necessary discriminations will be made; b) the presence of non-necessary information makes the task of discovering critical features more difficult and occasionally impossible. If children are to learn to discriminate the letters from one another, the exercises prepared must require that the response be dependent upon critical features of the letters and not on anything else. What we have called clutter is most common in primary readers. They have many irrelevant, colored pictures and full pages. The possibility of having the child make a response based on the critical features of a given word or sentence go down as the amount of clutter goes up. With so-called hyperactive children, this inability to control for clutter is belatedly evident in their distractability, their inability to attend, i.e., to discriminate.

Time. Harris (8) concludes his review of perception and reading with the statement: "Clear perception in reading, however, is more dependent upon what happens in the eyes." This writer considers his "in the eyes" to refer to the characteristics of light waves and considers that the retina is a functional part of the brain. With this interpretation, the conclusion that the differences between good and poor readers lie in differences in processing and not in intake acuity or response capability is clear. Several studies have shown that good and poor readers are not too different in ability to recognize words or symbols flashed quickly on a screen if there is a sufficient period of time in which to respond before the next S is flashed. There is, however, considerable difference in their performances when the S is followed quickly by another, even if the second presentation is a rather low level unpatterned array which need not itself be responded to. The conclusion is that the poorer readers need more time to process a "message" than do the better readers.

Vision. Low (14) has done several studies on the improvement of peripheral vision. "Subsequent studies with many test objects and limited viewing time have indicated that the principal requirement for improvement (of peripheral vision) is unlimited viewing time which permits the individual to 'work out' his impression of the stimulus. After some hours of such practice, peripheral stimuli become noticeable and the quantitative measures of the function show improvement."

Independent of the S or the required R, it then appears that individual differences in processing time exist for both the handling of familiar material and the initial attempts to become familiar with new material.

The Response. It may not be possible for O to make the required R, even though the stimulus is apprehended. Up to now we have not really looked at the problem of response relevance. Reading is usually considered as "getting the message" and the manner of demonstrating such acquisition is not often considered critical. One area of concern to reading teachers, spelling, requires production accuracy. It is not enough to be able to read the word, or even to recognize that a word is incorrectly spelled: to be correct it must be produced with only limited variations. This differentiation of learning into discrimination learning and production learning will be returned to shortly.

Emotionality. What Kaplan (11) calls arousal, Holland and Skinner (10) call emotionality and Semmelroth (16) calls non-specific tension. Arousal can exist from the slow, limited firing of deep sleep, through the alertness of being wide awake, to the extreme of such massive random firings that it is not possible to utilize previously acquired templates. In the last condition, the overwhelming noise of random input covers the "signal" produced by S so that matching cannot occur. The presence of non-specific tension is seen as disruptive of discrimination. This discrimination learning, then, can be viewed as a process by which non-specific tension becomes specific, i.e., controlled by need states on the organism side and by particular stimuli on the environment side. Set might then be viewed as a readiness to respond to a particular S, such readiness constituting arousal of templates by needs.

Frank Greene

In the reading process it may be that set versus emotionality has a relationship to foveal versus peripheral dominance. Under conditions of a specific set, the fovea would be dominant, the periphery would continue to guide movements, but clear central images would dominate. Under conditions of emotionality, foveal acuity would lose out to excessive peripheral control, and the eyes would move on even before a clear image was gained. In addition to erratic fixations, it would be expected that, under high emotionality, successful fusion would also be more difficult.

Peripheral acuity appears trainable. Low (14) reports that "The mean peripheral acuity increased from an initial 100% to 334% with individual extremes at 200-1200%. The improvement was found to transfer successfully to unfamiliar test objects, unpracticed retinal areas, limited viewing time, night visual acuity and situations in everyday life outside the laboratory. . . .Outside the lab, peripheral stimuli which had remained unnoticed beforehand intruded themselves on the consciousness without the individual having been thinking of training. In such situations as walking, driving, sports, and reading improved peripheral perceptual ability was recognized by the individuals."

Let me define discrimination learning as that type of learning experience during which the individual is "working out" some S array, identifying the critical features and putting down into memory storage whatever pattern now represents these critical features. During this stage, the R required need not bear any resemblance to the actual S. It is the stage of making templates of stimulus arrays: the template matches the S. Production learning occurs when O learns how to produce the critical features of some template so that the product matches the template. Using this paradigm, no complete production can be expected until discrimination is completed: the accuracy of the production is limited by the fidelity of the template.

Frank Greene

Summary. As teachers, if we use a perception frame of reference upon which to make our diagnosis of reading, our prescriptions will consider not only the visual stimulus, but also the conditions of emotionality during learning. Successful discrimination requires all three stages of the process to be functioning adequately.

REFERENCES

1. Attneave, F., "Some Informational Aspects of Visual Perception." Psychol. Rev., 1954, 61, 183-193.
2. Bevan, W., "Perception: Evolution of a Concept," Psychol. Rev., 1958, 65, 34-55.
3. Bruner, J. S., & Postman, L., "Perception under Stress," Psychol. Rev., 1948, 55, 314-323.
4. Burian, H., "Fusional Movements," Arch. of Opthal., March 1939, 21, 486-491.
5. Gibson, E. J., "Perceptual Learning," 1963 Annual Review of Psychology, Palo Alto: Annual Reviews, Inc.
6. Gibson, J. J., The Perception of the Visual World. Cambridge: Riverside Press, 1950.
7. Gilbert, L. C., "Saccadic Movements as a Factor in Visual Perception in Reading," J. ed. Psych., 1959, 14-19.
8. Harris, A. J., "Visual Sensation and Perception," J. devel. Reading, 1961, IV, 246-253.
9. Hebb, D. O., The Organization of Behavior. New York: Wiley, 1949.
10. Holland, J., & Skinner, B. F., The Analysis of Behavior. New York: McGraw-Hill, 1961.

11. Kaplan, S., *Arousal and Perseveration: A Theoretical Model*. Unpub. Ph.D. thesis, University of Michigan, 1962.

12. Keislar, E., "Shaping of a Learning Set in Reading." Paper read at meeting of Amer. Educ. Res. Assn., 1961.

13. Kossov, B. B., "Some Methods for Bringing Out Essential Features in Perceived Objects," *Problems in Psych.*, 1960, *1*, 71-81.

14. Low, F. N., *Peripheral Visual Acuity: A Review*. Psychological Branch, Human Resources Div., Office of Naval Research, Washington, D. C., 1950.

15. Miller, G. A., "The Magical Number Seven, Plus or Minus Two: Some Limits on our Capacity for Processing Information," *Psych. Review*. 1963, 81-97.

16. Semmelroth, C., "Increased Peripheral Sensitivity in the Visual Field as a Function of an Interference Task." Unpub. paper, Dept. of Psych., University of Michigan, 1963.

17. Smith, D. E. P., & Semmelroth, C., "Micro-movements During Apparent Fixations in Reading." Minneapolis: Third Yearbook of the North Central Reading Assn., 1964.

18. Smith, S. W., "Visual Search Time and Peripheral Discriminability," *J. Opt. Soc. Am.*, 1961, *51*, 1462. (A more extensive report is given in a Univ. of Michigan Institute of Science and Technology international memorandum: Smith, S. W., & Semmelroth, C., 24 Nov. 1961, "An Experimental Study Relating Search Time to Peripheral Visual Discriminability of Objects.")

19. Stevens, S. S., *Handbook of Experimental Psychology*. New York: Wiley, 1951.

Frank Greene

20. Witkins, H. A., et. al., Personality Through Perception: An Experimental and Clinical Study. New York: Harper, 1956.

21. Wohlwill, J. F., "Developmental Studies of Perception," Psych. Bulletin. 1960, 57, 249-288.

22. Zuckerman, C. B., & Rock, I., "A Reappraisal of the Roles of Past Experience and Innate Organizing Processes in Visual Perception," Psych. Bulletin, 1957, 54, 269-296.

A SELF INSTRUCTION PROGRAM FOR DISCRIMINATION TRAINING

R. Robert Geake
Greenfield Village Schools

In order to understand written material, the reader must recognize individual words and the letter symbols which compose them. The term recognition implies both discrimination and the maintenance of that discrimination over time, i.e., memory. Most teaching of beginning reading begins at the level of word recognition. The child learns a sight vocabulary or a few techniques for "sounding out" words or, more commonly, a combination of the two approaches. Significantly, most efforts at remedial teaching have also begun at the word recognition level, in spite of the fact that the child may have a long history of failure in discriminating and remembering words.

Thus we have come to think of reading comprehension as a complex skill which relies upon, and can only follow, the development of a previous skill at the level of word recognition. Yet is has been widely supposed that word recognition itself is a complex skill with its own set of underlying fundamental skills at the level of visual perception and neurological function. Recent research in visual discrimination and eye movement phenomena such as that reported by Smith and Semmelroth (2) support the multiple level position. This is a report of an attempt to identify some of the perceptual skills underlying the reading process and to improve these skills through training.

At the outset six skills were identified. The first was called tracking, i.e., the ability to stay on the right line of print as one reads. The eyes tend to make erratic jerks and momentary fixations in the wrong places. There is some evidence to support the hypothesis that in some cases the eye moves away from the line on which it is traveling to letters or groups of letters similar to those being processed, but in a nearby line of print. Difficulties encountered by readers deficient in tracking skill include missing lines, losing one's place, and reading words or parts of words which appear at places on the page other than the line apparently being read. The second perceptual skill is orientation in space, i.e., the ability of the reader to begin a line of print at the left and move his eyes along each line and each word in the line from left to right. Difficulties encountered by readers deficient in this skill include reversals and the reading of words in the wrong order. Both tracking and orientation may depend in some way on the four remaining skills, those found in factor analyses of perceptual tests, i.e., memory, speed, accuracy, and closure. The first three of these perceptual factors--memory, speed, and accuracy, may enter into the fundamental skill, discrimination.

Criteria were established for constructing exercises to provide training in the perceptual skills. Seven criteria emerged: 1) The exercises should provide training in the perceptual skills identified. 2) They should resemble the reading task sufficiently to provide for transfer to reading. 3) They should be simple enough to be used in the reading readiness program of kindergarten and first grade and yet be challenging to college students and adults in reading improvement classes. 4) They should proceed from very easy to difficult. 5) They should provide immediate knowledge of results, and reinforcement (reward) for correct responses. 6) They should allow each learner to proceed at his own speed, and 7) they should be self-correcting and require a minimum of teacher supervision.

The exercises which were finally developed to meet these criteria were assembled into a workbook titled Visual Tracking (1). The task is simply to find the letters of the alphabet in order, and to circle them, as one proceeds through a paragraph of eight to ten lines of nonsense words. When the learner finished a paragraph, he records the amount of time it took and then tries to finish the next paragraph in less time. The complete alphabet, in order, appears at the top of every page.

The task is so arranged that detection of each letter requires discrimination in the presence of a controlled amount of "clutter", i.e., competing stimuli. A d, for example, will ordinarily appear near a b, q, or p; or another d will appear in the preceding line at a point above or nearly above the correct one. However, the clutter is controlled. In the early paragraphs the letter size, letter spacing, and line spacing are sufficiently large to facilitate choice of the correct letter.

The skill required to complete the 160 exercises in the book is increased in nine steps as the size of type, distance between letters, and distance between lines of print is gradually reduced. Frequency of occurrence of each letter is approximately the same as that in ordinary text. Self-correction is provided for: if the correct letter is not detected the learner will not find it in the following line either. Thus he is aware immediately that he has made an error and he goes back to find it, with the lost seconds counting automatically on his total time.

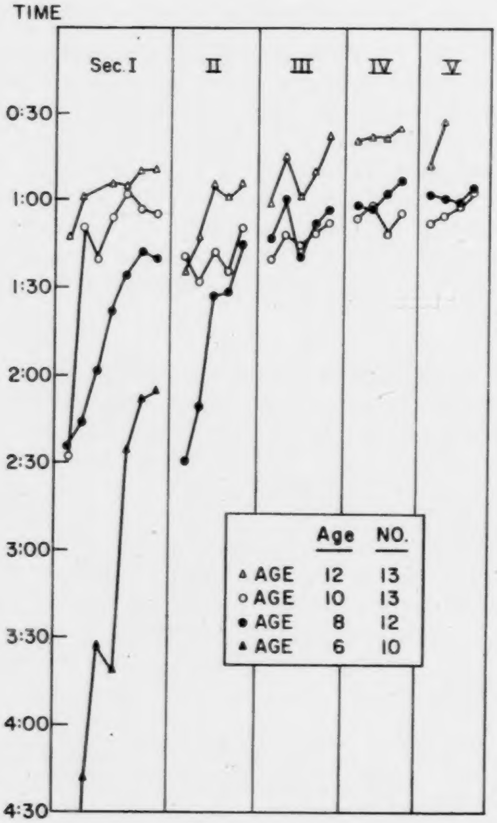
As the learner searches the paragraph of nonsense words he is practicing the perceptual skills. In order to finish successfully and in good time, he must stay on the correct line of print, proceed from left to right, and discriminate the individual letters (thus using memory and accuracy) at the highest speed at which discrimination is possible for him at his present level of skill. Reinforcement or "reward" occurs first as he finds each letter, and secondly when he records his time for all twenty-six letters at the end of each exercise. He is then encouraged to graph his scores on a progress chart which appears at the end of each of the five main sections of the workbook. As he reduces his time, the performance curve rises.

Validation procedures were begun with the first half of *Visual Tracking* in mimeographed form at the University of Michigan Reading Improvement Service early in 1962. The subjects were forty retarded readers, aged eight to thirty. In all but four cases, perceptual speed and/or accuracy increased. Transfer of skill to a test of perceptual speed and accuracy (Thurstone's *Identical Forms*) showed an average gain in speed of 22% and in accuracy from an initial level of 88% to a final level of 93%.

The first systematic investigation of the effectiveness of the exercises for children who are not remedial cases was carried out in grades two through five of the Greenfield Village Schools in Dearborn. A group of first grade children was given the first section of paragraphs only. At each of the other grade levels, a class of twenty-five children was divided into equivalent experimental and control groups on the basis of *Gates Reading Test* scores. The children in the experimental group in each of the grades were given the entire set of 160 exercises over a three to four month period. During the practice sessions the control groups were given other reading-related activities. Since the purpose of the study was to test the effect of the exercises as a *supplementary* teaching aid, regular classroom teaching of reading was continued for both groups.

Progress is recorded in Figure 1. The mean time scores decrease on each level of difficulty, while type size decreases from 18 point with wide spaces between lines of print in Section 1, to 10

R. Robert Geake



VISUAL TRACKING PROGRESS GRAPHS OF NORMAL READERS FROM PRIMER TYPE (I: 18 PT.) THROUGH NEWSPRINT (V: 10 PT.)

point with the lines very close together. At every stage of difficulty of the exercises, the older a child is, the more rapidly he completes the exercises. At each successive stage of increased difficulty, at first there is a drop in tracking rate followed by a gain which reaches a new level exceeding that of the former section. This habituation may be seen at each age level. But as skill and experience with the exercises develop, the drop at each new section no longer occurs.

As the experimental group in each class completed the workbook, the total class was retested with an equivalent form of the Gates Test. (See Table 1). In grade two, the experimental group was found to have improved significantly more than the control group on the Word Recognition Test, while no significant differences were found between the two groups in Paragraph Reading. It may be that skills developed by the tracking exercises are immediately applicable to word recognition skill but less directly applicable to reading comprehension.

Beginning with grade three, the Gates Reading Survey was used, yielding a rate score as well as a comprehension score. In grade three, the children who had had the tracking exercises were found to have increased in reading rate by an average of 25 w.p.m., as compared with an increase of 10 w.p.m. in the control group. In comprehension, the experimental group showed seven months improvement as compared with two months in the control group. These differences were significant at the .01 level of confidence. In grade four, no significant differences were found between the experimental and control groups on any measure immediately following the end of the training period.

In grade five, the children who had had the tracking exercises were found to have increased in reading rate by an average of 23 w.p.m. as

Table 1

READING RATE AND COMPREHENSION CHANGES AT END OF TRAINING AND ONE MONTH FOLLOWING END OF TRAINING

		N	Initial	Rate Change (WPM)		Comp. Change (Mos.)	
				End	One Mo.	End	One Mo.
Grade 3	Exper'l	12	93	+ 25**	+ 28**	+ 7.0**	+ 9.0*
	Control	11	91	+ 10	+ 11	+ 2.0	+ 2.0
Grade 4	Exper'l	12	118	+ 20	+ 26**	+ 3.0	+ 9.0*
	Control	13	115	+ 13	+ 13	+ 3.0	0.0
Grade 5	Exper'l	13	129	+ 23*	—	+ 1.5*	—
	Control	12	123	+ 11	—	+ .3	—

*Significant at the .05 level.
**Significant at the .01 level.

compared with an increase of 11 w.p.m. in the control group. This difference was significant at the .05 level, as was a corresponding difference in improvement in reading comprehension, also favoring the experimental group.

One month after the end of training, the children in grades three and four were tested with a third equivalent form to check on the durability of these gains. In grade three significant differences have increased. In grade four, where no significant differences were found at the end of training, the children who had the tracking exercises were now found to have increased an average of 26 w.p.m. as compared with an increase of 13 w.p.m. in the control group. In comprehension, the experimental group had improved nine months as compared with three months in the control group.

In general, however, it appears that the tracking exercises emphasize skills which are more closely related to those required for recognizing words than for reading generally.

REFERENCES

1. Geake, R. R., and Smith, D. E. P. Visual Tracking. Ann Arbor: Ann Arbor Publishers, 1962.

2. Smith, D. E. P., and Semmelroth, C. "Micromovements During Apparent Fixations in Reading." See this vol.

LEARNING TO READ AS A DISCRIMINATION PROCESS

Donald E. P. Smith
University of Michigan

Behaviors subsumed under the term reading may be viewed as a set of discriminations. A behavioral analysis of the process by which children learn to read reveals discriminations in the visual and auditory modalities singly and in combination, i.e., bi-modality discriminations. In the visual realm, components to be discriminated one from another comprise such apparent forms as letters, words and phrases and less obvious ones, such as spaces between words and points in space. The auditory components include phonemes and morphemes, and less obvious tonal "forms," such as words and word order within utterances. All of these components are within the stimulus domain. On the response side are vocal utterances and graphic behavior.

Sample Discriminations

The term, discrimination, as used here, refers to an organism's response when the learning environment includes:

1) two "equivalent" stimuli (i.e., each occasions the same response);

2) provision for a set to discover a difference between the stimuli; and

3) conditions which allow resolution of the task (i.e., discovery of a difference) by a sufficient visual or auditory search.

In the visual modality, the "equivalent" stimuli might be [d] , [b] , letters commonly confused; in the auditory modality, /r/, /w/ as in /rake/, /wake/, also confused. In bi-modality pairing, equivalent stimuli may be involved in the confusion of verb forms. That is, the visual signal ⌊He ran⌋ may elicit a vocal response appropriate to the visual signal [He run] , (spoken /he rən/). Failure to discriminate may have occurred in any one of three component tasks:

1. Visual task

$$[\mathrm{ran}] \equiv \begin{cases} [\mathrm{ran}] \\ [\mathrm{run}] \end{cases}$$

In this case, the configurations of the words, [ran] and [run] , are similar enough to account for the error. But given evidence that the visual discrimination has been made, the error might then be a failure to discriminate in the auditory modality:

2. Auditory task

$$/\mathrm{ran}/ \equiv \begin{cases} /\mathrm{ran}/ \\ /\mathrm{r}\text{ə}\mathrm{n}/ \end{cases}$$

In this case, the child may be unable to discriminate between /ran/ and /rən/ for organic reasons, or more commonly, may fail to do so because the sounds are not phonemically different in his dialect, i.e., others in his culture use them interchangeably or use one form for two referents. But given both the visual and the auditory discriminations, the error may still occur:

3. Aural-visual task

$$[\mathrm{ran}] \equiv \begin{cases} /\mathrm{ran}/ \\ /\mathrm{r}\text{ə}\mathrm{n}/ \end{cases}$$

In this case, the responses /ran/ and /rən/ may be equally probable in the presence of [ran]. The learner has failed to associate the equivalent visual and auditory signals. The bi-modality discrimination illustrated here is more commonly called paired-associate learning.

The single modality and bi-modality discriminations described above constitute the major lines of inquiry in a task analysis of the learning-to-read process. When the components of literacy are viewed as discriminations, some of the knotty problems of early reading instruction are resolved, others are reduced, and still others do not arise at all. Furthermore, the task of teaching is facilitated. Techniques for educing discriminative behavior are readily available. For example, the matching-to-sample task has proved to be a useful technique for shaping behavior, both in experimental animals and in man (8, 11).

This paper presents a task analysis of literacy viewed as a set of discriminations. Reading, writing and listening were programmed as a series of discrete and, later, of interwoven, match-to-sample tasks. They were field tested and revised as necessary until a sample of low-average, first grade children were uniformly successful on the material, i.e., learned to read.

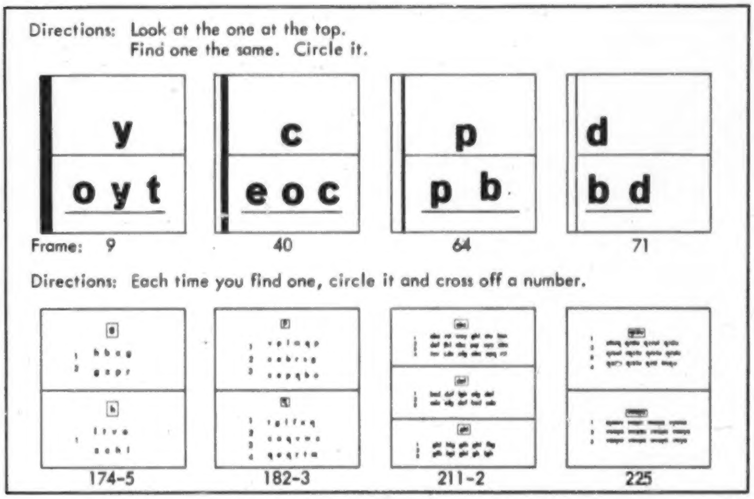
The Learning Paradigm I
Single Modality Discriminations

While part of the task analysis preceded the programming effort, much more was accomplished as a result of observing children's behavior in the presence of the task. Thus it is appropriate here to describe "frames" which illustrate the task.

1. Form discrimination

The learner is presented with a sample or "model" and two or three choices. In early frames he discriminates single letters. Later the task requires finding groups of letters and, finally, groups in the correct order. (Figure 1)

The increase in complexity from frame 9 to frame 225 was carefully controlled. If a change in the format occurred, an "easy" discrimination was required on that task. Thus, after revisions, all pages are roughly comparable in difficulty, judging from children's responses. Revisions were

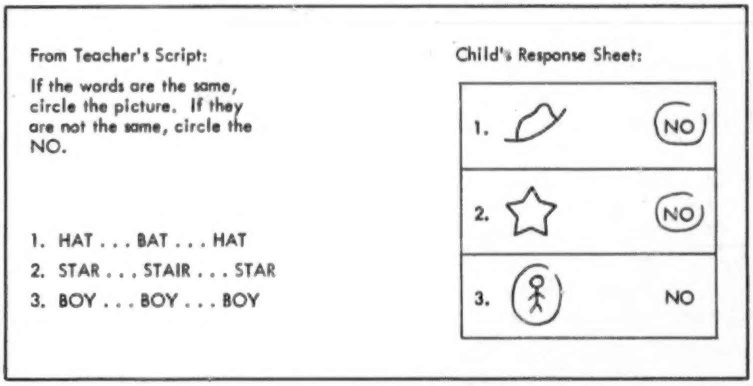


Directions: Look at the one at the top.
Find one the same. Circle it.

Directions: Each time you find one, circle it and cross off a number.

y
o y t
c
e o c
p
p b
d
b d
Frame: 9
40
64
71
174-5
182-3
211-2
225

Figure 1. Letter discrimination frames from a basal reading program.



From Teacher's Script:

If the words are the same, circle the picture. If they are not the same, circle the NO.

1. HAT . . . BAT . . . HAT
2. STAR . . . STAIR . . . STAR
3. BOY . . . BOY . . . BOY

Child's Response Sheet:

Figure 2. Phoneme discrimination frames from a basal reading program.

continued until all tasks reached the criterion of 95% correct responses.

2. Phoneme discrimination.

The task design for discriminating phonemes is analagous to that in the visual modality. Contrastive pairs of words are presented. The members of the pair are identical in sound except for one phoneme, as /cat/ /bat/; /cat/ /cut/; /cat/ /can/. Note that the phoneme contrast is in the initial, middle and final position of the words in the above examples. In the visual task, the model remains available during the search. In the auditory task, the model occurs twice, in the first and third positions, with the contrasting word in the middle position (Figure 2). Half of the choices are, of course, same words. The child is required to determine only whether the pairs are same or different. Each of the 43 phonemes of English is contrasted with every other phoneme in the positions within words in which they ordinarily occur.

Some 1100 frames, half of which include contrasts, constitute the discrimination program for phonemes. All words used are picturable nouns. No "pay-off," confirmation or other extrinsic reinforcer is given and none appears necessary. Each task is equivalent to a novel stimulus array. In the visual task, uncertainty is reduced, i.e., habituation occurs, when a difference is discovered between the model and a distractor. When that same difference is not found in the correct choice, the task is resolved, i.e., the learner has found "the same one." In the auditory task, the phonemic contrasts are carefully graded. At a given level of discriminative training, the succeeding contrast is clear enough for the forced choice, yes-no decision to be made. At the moment of decision, uncertainty is resolved.

In both the visual and auditory modalities, the behavior occurring immediately prior to uncer-

Donald E. P. Smith

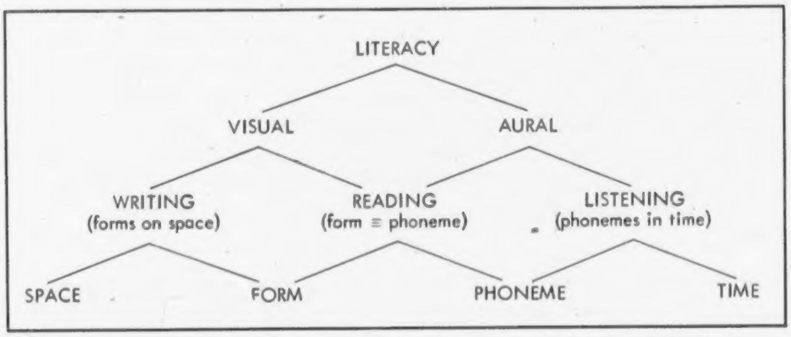

LITERACY
VISUAL
AURAL
WRITING
(forms on space)
READING
(form ≡ phoneme)
LISTENING
(phonemes in time)
SPACE
FORM
PHONEME
TIME

Figure 3. Classes of discriminations required for literacy and their relationships.

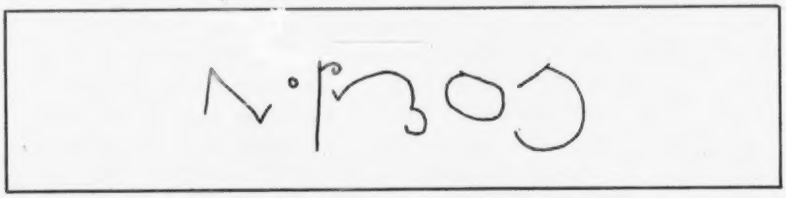


Figure 4. Norman's rendition of his name (age 7).

tainty reduction is thought to be the behavior learned. For example, in the visual situation, the learner searches for the point of contrast in two similar letters. The cross bar and absence of a cross bar in [e] : [c] is the part which "makes the difference", the discriminandum. Attending to the discriminandum is reinforced by resolution of the task uncertainty, "finding a difference." Thus, what is reinforced, i.e., learned, is attending to points of difference in letters. In the auditory situation, attending to the parts of words which provide a phonemic contrast is reinforced by perceiving such a contrast.

One effect of the training would appear to be an increase in accuracy of reception, with a corresponding decrease in variability of response to the signal. One can observe the gradual reduction in "restlessness" (noise-related random behaviors) during the auditory task over a period of a few days.

Another apparent effect of the training is an increase in time spent attending to spoken language. There is an increase in sustained attention during the auditory task, from five minutes at the beginning of training to about twenty minutes after three weeks, accompanied by a reduction in errors.

The Structure of Literacy

We assumed some primitive grasp of English, its basic vocabulary and syntax. Literacy was then presumed to embrace reading, writing and listening. A simplified schema of the perceptual competencies constituting literacy is presented in Figure 3.

Writing is viewed as a task primarily within the visual modality and based upon form and space discrimination. Listening is an aural task based upon perception of patterns of phonemes over time. Reading is unique in its dependence upon a visual equivalence to a phonemic signal. To illustrate the relationships in Figure 3, let us consider the problem of learning to do manuscript writing. This skill is viewed herein as essentially a visual task. The learner is required to discriminate from one another such similar forms as [b d p q] , [f t] , [h n u v w] , etc. When he attempts to reproduce them, he is required to do so by imposing them upon a given "space." Children commonly draw letters of greatly disparate size and orientation (Figure 4). At a given time step, t_1, Norman must choose a point in space, the limits of which are the edges of his paper, and arrive there at t_2. If he is unfamiliar with the space, he will tend to overshoot or undershoot the mark. As a result, he must carry out a substantial amount of trial and error behavior. The writing task, then, is viewed as requiring the imposition of forms on space. If training in the perception of points in space were to precede the writing, much of the error should be avoided. Sample tasks appear in Figure 5. A nine point matrix is required for manuscript writing. Tasks include, in increasing difficulty, two, three and four point arrangements. After some fifty frames, the learner moves on to the discrimination of the locus of forms on space and, then, to the production of the letters, with and without support (C). Later frames teach the use of the paper edge as a reference frame, followed by the use of adjacent letters for that purpose.

The Learning Paradigm II

Form-phoneme equivalences first occur in the learning of words. Selection of words to be presented required that we take a position on some long-standing problems of reading instruction. The perennial problem of "phonics," i.e., phonemic analysis, may be stated as follows: A verbal response to an unknown word is facilitated by a response to some known part of it. For example, the [ph] in [phone] is a common graphic equivalent of the phoneme /f/. The resulting phonemic analysis

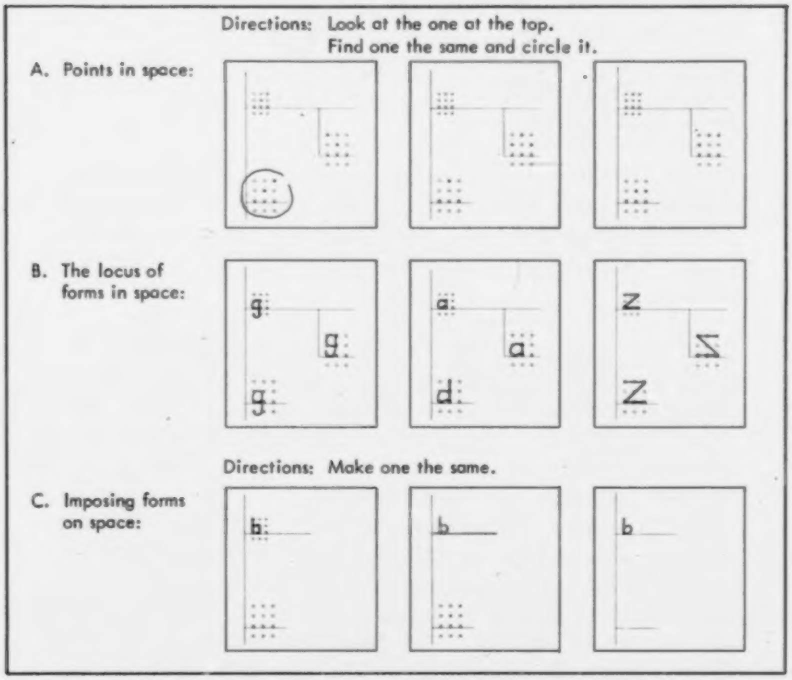

Directions: Look at the one at the top.
Find one the same and circle it.
A. Points in space:
B. The locus of forms in space:
g
g
g
a
a
d
Z
Z
Z
Directions: Make one the same.
C. Imposing forms on space:
b
b
b

Figure 5. Training tasks for (A) discriminating space, (B) discriminating the locus of forms in space, and (C) imposing, forms on space (writing).

is commonly called "sounding out" words. Nearly all investigators agree that some skill in phonemic analysis is necessary for reading. How and when it should be taught is the issue. Gates and Russell (4) and others (1, 6) maintain that skill is likely to occur spontaneously in some children after they have learned a number of "sight" words, words of high associative value which are recognized without analysis. Other children will then need only incidental instruction. Other specialists contend that systematic instruction in grapheme-phoneme pairs should precede the learning of words (5). Evidence thus far has been equivocal, partly because control of classroom variables has been inadequate.

Since discrimination of the parts constituting a novel array usually follows discrimination of a primitive whole (7), we followed the recommendation of Gates and began instruction with sight words.

Another issue to be faced was that raised by Bloomfield (2). Which sight words should be used? Early investigators suggested common nouns and function words, the former because of their associative value and consequent ease of learning, the latter because of their ubiquity. For example, some 210 words provided by Dolch account for some 67% of all words in third grade readers (3). Bloomfield took issue with the contention that associative value and commonness should determine selection of words. He pointed out that a large proportion of function words are not "regularly phonemic," i.e., are not representative of the sound-symbol regularities of the language. Thus a heavy burden is put on the child: he is required to master words with elements of limited transfer value.

We begged the question by selecting both function words and Bloomfield's list of phonemically regular words. We then arranged the task so that the child learns both regularities and irregularities.

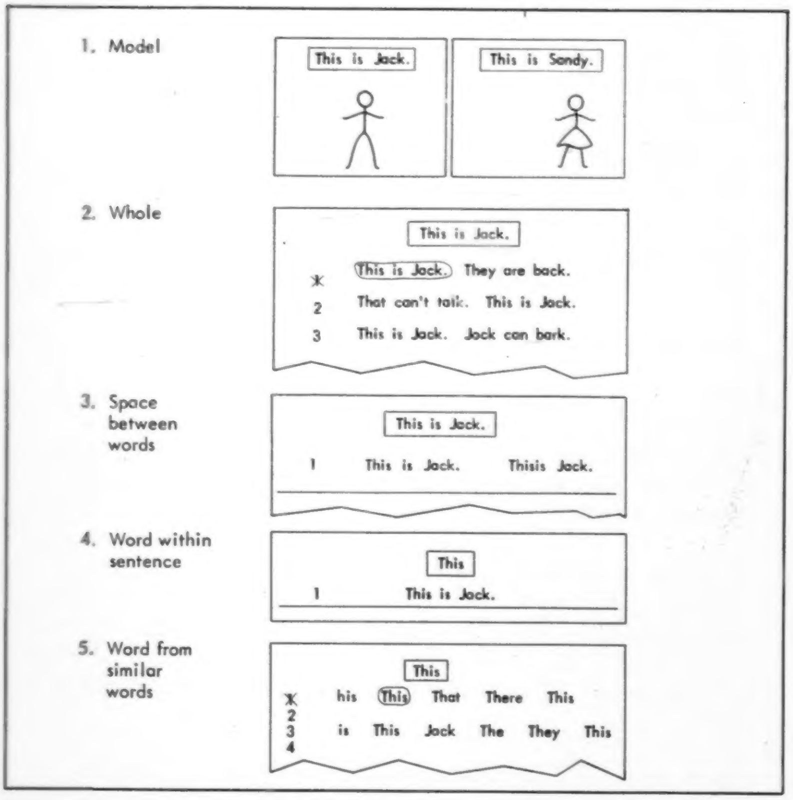

1. Model
This is Jack.
This is Sandy.
2. Whole
This is Jack.
* This is Jack. They are back.
2 That can't talk. This is Jack.
3 This is Jack. Jack can bark.
3. Space between words
This is Jack.
1 This is Jack. Thisis Jack.
4. Word within sentence
This
1 This is Jack.
5. Word from similar words
This
* his This That There This
2
3 is This Jack The They This
4

Figure 6. Sequence of discriminations for the visual component in the learning to read process.

1. Form discrimination

The learning paradigm for words is analogous to that of the letter discrimination program but more complex.

In Figure 6, Step 5 illustrates the embedding of the word [This] among distractors consisting of common words increasingly similar in configuration. Searching the array requires a matching to sample of each word, thus discovery of the parts of the word which make it unique.

It will be noted, however, that a number of steps precede this one. While children's reading difficulties often arise from faulty perception, they sometimes result simply from "unavailability" (9, 13) of a word learned on a previous trial. To facilitate retrieval, all words are presented in the context of a story.

The story is learned as a whole in the auditory portion of the program with the aid of simple stick figures. If a word is not available, the learner has recourse to the model, the original sentence with picture cue.

As one discovers when programming for children, "simple stories" and "simple stick figures" are not simple. The "reading" of stick figure representations of common syntactic relationship [This is my dad] also required extensive programming (not shown).

When the child "knows the story", i.e., emits the sentence when presented with the illustration, he moves to Step 2, discrimination of the whole sentence among similar wholes. Steps 3 and 4, the teaching of spaces between words and words within the sentence, resulted from discovery that some children were not aware that the word [This] had appeared (as a non-isolated) part of Step 2. Subjects can be relied upon to make only those discriminations required by the task.

To this point, the child has carried out only the visual task. Before form and phoneme are associated, he must make certain discriminations in the aural modality.

2. Morpheme discrimination.

The assumption of a knowledge of English by our first grade children was simply uninformed. Our subjects had only a primitive grasp of their native language. The phoneme discrimination program described above appeared to increase their competency.

Their teacher reported a class-wide increase in the use of adjectives in spontaneous speech thereafter. Another problem, however, was the discrimination of words within a "vocal utterance." As linguistic investigators are aware, the sentence /This is Jack/ may well be considered to be one word. To realize that /I'm a boy/ and /She's a girl/ contain several words requires a good deal of linguistic sophistication.

A program was designed to provide for discrimination of all words taught within the story sentences in which they appeared. It was followed by an oral language program providing for the use of those words in sentences constructed by the children.

3. Aural-visual discrimination.

The form-morpheme association in reading is usually viewed as a particular case of paired-associate learning. But it need not be so construed. Paired-associate learning may, instead, be viewed as a special case of discrimination learning. The following conditions are required.

a) A model or sample is available to the learner;
b) The aural-visual pair to be associated is

discriminated from three kinds of distractors rather than from the one kind required in single modality learning:

i. It is discriminated from aural-visual pairs already in the repertoire of S.

Example: The child knows the equivalence of [Sandy] :/Sandy/ and [Jack] : /Jack/. He is about to learn [This] :/This/.

Teacher's Script

I am going to say a word: *This*. Look at number 1.
Which word says *This*? Circle it.
Number 2. Which one says *This*?

Response Sheet

1. This ________ Sandy
2. Jack ________ This

ii. It is discriminated from aural-visual pairs consisting of the *visual* form to be learned paired with an incorrect *auditory* signal.

Teacher's Script

I am going to say a word. If it is the same as the word on your paper, circle the word. If not, circle the No.

Number 1. /Jack/
Number 2. / Sandy/
Number 3. /This/

Response Sheet

1. This ________ No
2. Sandy ________ No
3. This ________ No

iii. It is discriminated from aural-visual pairs consisting of the auditory signal to be learned paired with an incorrect visual form.

Teacher's Script

I am going to say a word. If it is the same as the word on your paper, circle the word. If not, circle the No.

Number 4. /This/
Number 5. /Jack/
Number 6. /This/

Response Sheet

4. Sandy No
5. Jack No
6. This No

The formulation of the paired-associate task in terms of discriminations may provide a control of the learning process not previously available. Such control is necessary for effective programming.

4. Production.

Skill in phonemic analysis is thought to develop when the following condition obtains: Vocal production of the phoneme in a word occurs concurrently with viewing the graphic equivalent of the phoneme. This condition can be fulfilled when the paired-associate task is completed. At that time, on observing a word, the child emits its name, i.e.,it is now a "sight" word. He next carries out this procedure:

```
This   is   Jack
_is    is   _ack
Th__   __   Ja__
____   is   J_ck
Th_s   __   ____
This   is   Jack

____   __   ____
```

A complete phonemic analysis is included for each word he learns (349 in the total program). The child writes the sentence completely each time through, producing the graphic equivalent of each phoneme while completing each word. Since the vocal production occurs spontaneously in the presence of the word, the foregoing condition for learning phonemic analysis is fulfilled.

Later stories narrate various adventures of Jack and Sandy. Increasing amounts of alliteration and rhyming are introduced in order to accentuate the sounds of the language. A terminal part of the word program requires systematic use of phonemic analysis to identify unknown words.

Independent reading occurs at that point. Thereafter, common phrase structures in the language are programmed, followed by a set of transformations and substitutions required for comprehending sentences. The terminal part of the program is concerned with paragraph analysis.

Problems and Solutions

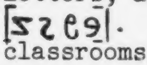
Problems requiring solutions provided useful information about the perceptual process in these children.

Letters. One rule-of-thumb in programming is to specify the behavioral outcome desired and to teach it directly. Since the discrimination of letters was one objective, the first frame (independent of directions) is number 9 in Figure 1. If subjects had been unable to make that discrimination, further analysis would have been needed.

The field trial was carried out with 19 first grade children, all of whom were judged to be unready for first grade. Since all the children responded correctly, no further analysis of components was required. More primitive children might require a program in length, direction, and continuity of line, in contours and enclosed areas.

Problems which arose are illustrated in Figure 7. Note the added horizontal line in the revised frame for the [b] : [p] discrimination. Child's comment: "This one [P] comes closer to the line (pointing to the added line) than that one [d] ." We infer that extension of the [p] is first discriminated by noticing its relationship to an external referent, such as a line.

In a similar way, the resolution of the [d] : [b] discrimination suggests that the difference in the shape of the space between the letter and the orientation line is the initial discriminandum. In the first revision, there is no difference in the shape of that space, thus, no difference is noted. When queried after completing the second revision, a child verbalized, "This one [d] points at the line. The other points away." Apparently, the "direction of bend" now becomes the discriminandum.

Writing. As noted earlier, manuscript writing may be viewed as the imposition of a previously discriminated space. Errors, such as reversed letters, are not unusual among normal children: . One condition of practice common in classrooms is the repetitive production of one letter with the dictum that the same sequence of movements be used. The letter shapes rapidly deteriorate for some children. Others are able to continue drawing acceptable shapes but their sequences of movements alternate.

Such alternation behaviors were found in other tasks: turning pages in the wrong direction; moving alternately from left hand choices to right

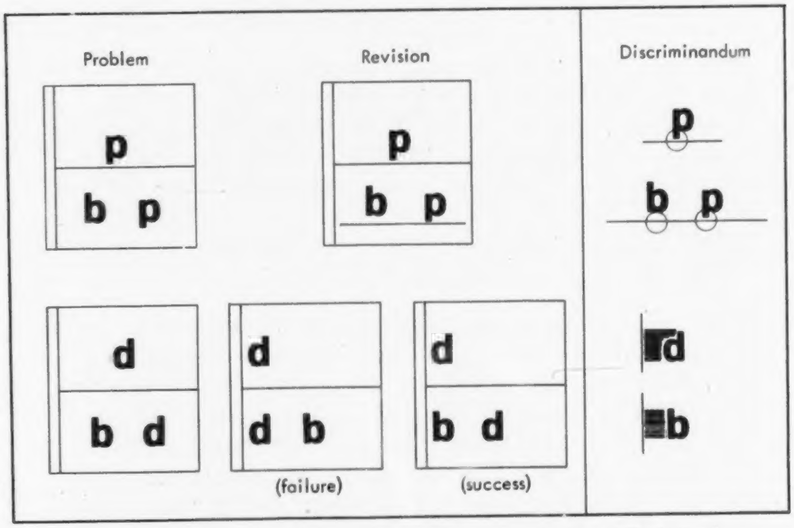

Problem
p
b p
Revision
p
b p
Discriminandum
p
b p
d
b d
d
d b
(failure)
d
b d
(success)
d
b

Figure 7. Problem frames illustrating use of an external referent (horizontal or vertical line) for initial discrimination.

hand choices on response sheets; completing the top task on one page, the bottom on the next, the top on the next, etc. When children were allowed to stop a task at will, the incidence of alternation behavior appeared to diminish. Thus, self pacing (10) was introduced to the program.

Concerning the writing task, review of the samples from the writing program above will demonstrate how we resolved this problem. In effect, the child may make the letters with any sequence of movements. Furthermore, we have substituted discrimination tasks for repetitive production.

The Learning Paradigm III: The Milieu

Children repond to a novel situation in the same fashion as do experimental animals: They are "emotional"--fearful, aggressive or immobile. The paper and pencil learning task as a source of uncertainty is overshadowed by uncertainty represented by a novel environment. But, while experimental animals must habituate only to a stable, unchanging apparatus, children must develop appropriate responses to a classroom, to a teacher and to other children. None of these sources of uncertainty remains stable. The room is changed unpredictably by the addition of student art work, chalk board announcements and a variety of educational flotsam introduced by others. The variable behavior of other children is a continuing source of uncertainty. Much of a child's interaction with other children is repetitive, apparently an attempt to determine predictable responses from them. "When I pushed him, he said, 'Stop that!' If I push him today, he'll say, 'Stop that!'"

Since much of the child's repertoire of coping behaviors has been learned in the presence of adults, the teacher tends to be the most likely source of uncertainty reduction and, thus, the focus of the child's habituation responses. And how predictable is the behavior of the teacher?

Donald E. P. Smith

In the presence of certain task-irrelevant pupil behaviors, teachers' responses are relatively predictable. She responds to hand-raising, smiling, requests for help and seductiveness by various supportive behaviors. She responds to "nervous habits" (i.e., random behaviors), a variety of aggressive acts and to masturbatory activities with punitive behavior. To the child in an extreme state of uncertainty, a predictable response is reinforcing no matter what its apparent intent. Thus, children are shaped into dependency, fawning and seductiveness, on the one hand, and withdrawal on the other.

Irrespective of the value of such training, one result is a lack of opportunity to learn the skills which are the presumptive reason for the educational enterprise. The skill task tends to be used instead as a ground on which is played a two-way interpersonal relations game in which child and teacher take turns acting as the manipulandum.

Producing a stable environment. One way to provide a stable environment is to reduce the number and kinds of stimuli to which the teacher must respond. The teacher was trained to "not respond" to task irrelevant behaviors of the children. To "not respond" is a complex response. The end result of training is the ability of a teacher to continue an activity in the presence of a normally disruptive child behavior. The effect on the child's behavior is clear and pronounced. First, his previous coping behaviors in the presence of adults simply extinguish in the presence of the teacher. Second, an important source of uncertainty reduction, the teacher's behavior, is removed. The learning task remains. Since it is carefully programmed, the child is able to encapsulate his uncertainty within task requirements and to reduce it by resolving the task, i.e., by attending to the appropriate discriminandum. And, since the teacher does not respond to irrelevant behaviors (including requests for help or requests for commendation), all reinforcement must be derived from task relevant behavior.

Donald E. P. Smith

The Teacher's Role:

1. Direct control: The teacher used two control techniques.
    a) New activity. Before any new group activity was initiated, the teacher said, "Sit quietly and fold your hands." She waited for absolute compliance before beginning the new activity.
    b) Ongoing activity. Behavior was not responded to, with one exception. A crisis situation was defined as a behavior which distracted other children. The distracting child was removed from the group temporarily, without comment.

2. Indirect control:
    a) Physical arrangements. The primary source of control consisted of arrangement of the environment. For example, after the child was removed, an analysis was made of the environmental variables contributing to his difficulty. A hyperactive child was placed next to one wall and facing another, unpatterned wall, thus providing relief from distraction. A suspicious, aggressive child was placed in the last seat of the last row so that he was able to keep everyone under observation.

       Information dictating an environmental change was derived from observation of the group and of the response booklets. For example, consistent errors in auditory discrimination were thought to be due to stress. One fearful child was placed near the teacher and his error rate reduced sharply. After two days, the rate began to increase again. He was then placed in a protected position, facing out from a corner. His error rate dropped sharply again and remained low thereafter.
    b) Task modifications. Errors common to

several children indicated inadequacies in another part of the environment, the program. A task analysis was carried out on the same day and revised materials were usually ready for all the children on the following day.

Teacher training. Teachers involved in use of the program during its development were trained *in situ*. Thereafter, the training procedures were programmed along with methods of task analysis and the programming of discrimination tasks in literacy training for inclusion in the *MANUAL* (12). The effectiveness of this method of training has yet to be determined.

Changes in behavior. The foregoing description of environmental control may call forth in the reader a vision of a cold, sterile learning situation. In actuality, such a result did not occur. The most common reaction verbalized by visitors was the eagerness and orderly activity of the children when they stopped working. Three of the children had been "school refusals" the previous year. The problem did not recur. None of the children was seen by a visiting teacher. Behavior problems from the previous year either failed to occur or had diminished to acceptable levels.

Summary. An analysis of skills constituting literacy yields a series of discriminations. Single modality discriminations of visual form and space and of phonemes and time provide skills which can be combined within the discrimination paradigm to yield reading, writing and listening skills. All discriminations are arranged as match-to-sample tasks. Phenomena described elsewhere in terms such as unavailability, alternation behavior, habituation, eye-hand coordination, and behavior problems are discussed within the discrimination paradigm. It is suggested that adequate programmed materials and teacher training may provide an effective educational and therapeutic milieu.

REFERENCES

1. Anderson, I. H., & Dearborn, W. F. *The Psychology of Teaching Reading*. New York: Ronald Press, 1952, 210.

2. Bloomfield, L., & Barnhart, D. L. *Let's Read*. Detroit: Wayne State University Press, 1961.

3. Dolch, W. *A Manual for Remedial Reading* (2nd ed.). Champaign: Garrard, 1945.

4. Gates, A. I., & Russell, D. H. "Types of Materials, Vocabulary Burden, Word Analysis, and Other Factors in Beginning Reading." I and II. *Elem. Sch. J.*, 1938, *39*, 27-35, 119-128.

5. Hay, J., & Wingo, C. E. *Teacher's Manual for Reading with Phonics*. Philadelphia: Lippincott, 1948.

6. Harris, A. J. *How to Increase Reading Ability*. New York: Longmans, Green, 1956, 316.

7. Hebb, D. O. *The Organization of Behavior*. New York: Wiley, 1949, 19 ff.

8. Holland, J. G. "New Directions in Teaching Machine Research." In Coulson, J. E. (ed.) *Programmed Learning and Computer-Based Instruction*. New York: Wiley, 1962, 46-57.

9. Kleinsmith, L. J., & Kaplan, S. "Paired-associate Learning as a Function of Arousal and Interpolated Interval." *J. exp. Psychol.*, 1963, *65*, 190-193.

10. Olson, W. C. *Child Development* (2nd ed.) Boston: D. C. Heath, 1959.

11. Skinner, B. F. *Cumulative Record* (enlar. ed.) New York: Appleton-Century-Crofts, 1961, 61-69.

12. Smith, D. E. P., & Kelingos, J. *Manual: A Program for Teachers*. Ann Arbor: Ann Arbor Publishers and Operant Associates, 1964.

13. Walker, E. L., & Paradise, N. "A Positive Correlation Between Action Decrement and Learning." *J. exp. Psychol.*, 1958, *56*, 45-47.

I am deeply indebted to my colleagues who shared in this two year investigation: Carl Semmelroth resolved numerous complex issues in discrimination learning; Judy Kelingos Smith was the major programmer and contributed largely to the task analysis; Frank P. Greene, now at Rutgers University, contributed to the analysis of bi-modality learning; Dale M. Brethower shaped our efforts in operant techniques. I remain fully responsible for any remaining errors.

CRITIQUE OF
"LEARNING TO READ AS A DISCRIMINATOR PROCESS"

Philip Clark

I am a bit of an outsider among these people who are busily engaged in the design and testing of programmed materials, since I am not. I am concerned, however, with certain features of this approach which have high relevance for behavior change, which I see as the aim of education.

I would like to present what seem to me to be two major advantages of the approach Dr. Smith has outlined.

The first of these two major advantages is that this approach focuses the child's attention and effort on the material. This point may seem unimportant at first, but when one considers the tension-reducing possibilities embodied in the teacher, and the teacher-satisfying behavior resorted to by pupils as a substitute for the learning they are "supposed to be doing," this focusing of attention upon the materials assumes dramatic significance. Here the attempt is to make the mastery of the material in question the "only" outlet for the child's needs. To the extent that this "behavioral control" is successful, the child must satisfy his needs through activities directly relevant to the "task-at-hand." I find this, at very least, an admirable economy and, at best, an invaluable service to the child in terms of his development of a generally task-oriented approach to uncertainty reduction (or need reduction) which, I would postulate, would be a highly adaptive strategy.

Perhaps even a more obvious advantage of this approach is that it focuses attention upon the behavior of the individual and away from inferences about what is occurring in his private mental world. The programmer must, at each step, specify

Philip Clark

the response to be emitted by the child This operationalization, not only of objectives but of each step in the process leading to attainment of the final skill, forces the educator to be specific about what he wants to accomplish. This "task analysis" procedure might be construed as an attempt to define that fuzzy "learning process" we enjoy talking about but can't quite specify, in terms of products which are specified in the form of the responses emitted in the frames.

It is these two features, then, of Dr. Smith's approach which recommend it most highly to me: 1) A realistic and positive motivational focus, and 2) an emphasis upon what we can observe and specify.

I have two questions to raise concerning the approach. The first depends somewhat upon whether it is expected that this technique is generalizable to a normal population of pupils. There seems to be an implicit assumption here that a significant amount of uncertainty will be reduced for all pupils by the same materials. I suppose my question is: "Won't there be some pupils for whom the pace is too slow, that is, who aren't sufficiently uncertain to maintain enchantment with the task or for whom the task has little perceived relevance?" Won't some subjects be "bored silly" with the program? The "subjects" mentioned in Dr. Smith's paper were "low normals." How generalizable is the technique?

Another question is: "Is it expected that this approach will lead to general reading skill independent of the criteria involved in the program itself?" If so--and I can't imagine otherwise--what is the prospect for experimental studies designed to test the influence of this technique as contrasted with that of others for teaching reading?

CLOSURE AND THE CLOZE PROCEDURE

Earl F. Rankin, Jr.
Texas Christian University

The primary purpose of this paper is to review selected studies on closure relevant to the cloze procedure. As a result, we may gain some insight into the role of closure in the reading process.

The Cloze Procedure

Definition

The cloze procedure is a technique for measuring the effectiveness of communication by determining the degree of language correspondence between a message source and a receiver. This is accomplished by deleting words from a message in some mechanical fashion and asking the receiver of the message (i.e., the reader or listener) to predict from the remaining context precisely what words were deleted. To the extent that the message source and the receiver share common language patterns, communication will be effective, and the degree of effectiveness will be revealed by the ability of the receiver to make correct predictions regarding the exact word the message source used at various choice points in the message.

Rationale

A theoretical rationale for the cloze procedure is to be found both in Gestalt theory and information theory. The term "cloze" is derived from the Gestalt term "closure" which (for the time being) we shall define as the tendency to fill in gaps in an incomplete structure. When the receiver fills in the correct word which has been deleted from a message, he has achieved "closure" (i.e., the sentence or paragraph pattern is now complete). When closure has taken place, the message (or some part of the message) now makes sense to the receiver.

Another way of viewing the cloze procedure is from the viewpoint of information theory.[1] In simple terms, "information" is communicated to the extent that a message unit (e.g., letter or word) is not predictable from the previous message context. The opposite of "information" is "redundancy" (or predictability). A difficult message containing unusual words organized in atypical grammatical patterns would be highly unpredictable and, hence, would communicate more information than a redundant message containing many cliches so that the receiver could easily tell "what is coming next" at any point in the article. The cloze procedure allows one to sample the degree of information (or redundancy) in a message by counting the number of correct predictions made by the receiver. Taylor (57) obtained a correlation of -.87 between cloze scores and a measure of "information" on a sample of continuous prose.

Relationship to Reading

Several investigators have shown the value of the cloze procedure to the study and improvement of reading. Taylor (56) has demonstrated its use as a measure of readability. Rankin (39, 40, 41) has shown its value as a measure of reading comprehension. Jenkinson (23) has revealed its potentialities as a diagnostic tool in the reading clinic. And Bloomer (6) has shown that it has value as a technique for constructing reading improvement exercises.

---

[1] The relationship between "closure" and "information" will be shown in the next section.

Earl F. Rankin, Jr.

The Nature of Closure

Definition

According to Gestalt theory, psychological organization always tends to move toward a state of Pragnanz (i.e., a good Gestalt). A good Gestalt is characterized by simplicity, regularity, and stability. Closure (i.e., the tendency to fill in gaps in an incomplete structure) is a special case of the Law of Prägnanz. As Woodworth (66) has pointed out, "The tendency to close a gap is akin to the tendency to overlook irregularities, and in general to see as 'good' or 'pregnant' a figure as possible under the given conditions." (p. 130)

In elementary psychology texts, closure is usually presented as one of the primitive organizing tendencies in perception. However, the term is not limited to perceptual phenomena. Let us look at a few definitions which illustrate the generality of this concept. Tiernan (60) states,

> . . . the organism, when confronted by a situation which is non-symmetrical, incomplete, out of rhythm--the situation may be an open triangle, an unsolved arithmetical problem, the pangs of hunger--labors under a stress or strain until the disturbing situation is adjusted and equilibrium reached. The final stage when the tension is released and equilibrium reached is known as closure. (p. 97)

Murphy (34) defines closure as,

> . . . a basic principle whereby the tension initiated by a situation is resolved and the configuration (whether of behavior or of mental process) tends to as complete or 'closed' a condition

> as the circumstances permit. An interrupted sneeze or a face in profile without a nose is an unclosed configuration which one tends to complete. (p. 982)

Bobbitt (7) defines it as,

> . . . any psychological phenomenon in which a condition of incompleteness, either in the stimulus field or in some phase of the organism's activity, creates a tendency to overcome this incompleteness by perceptual reorganization, by a combination of two or more experiences, or by some overt activity of the organism. (p. 137)

The generality of the term has led to some criticism. Schoenfield (45) feels that it has never been adequately defined as a perceptual phenomenon and that its extension to other behavioral levels is unwarranted. He states, "Gestalt psychologists have been much too free in the use of the term, and have reduced it to the status of a metaphor which they loosely apply to a wide range of behavior." (p. 496) In any case, whether or not one agrees with this criticism, it is clear that the concept of closure has been used to apply to thinking and overt behavior as well as perception.

At the perceptual level, the term sometimes refers to a situation where one actually perceives the gaps as being filled in (as in tachistoscopic studies of closure). In other perceptual studies the missing parts are not actually seen. Instead, the remaining parts are organized as belonging to a complete figure despite the gaps which are clearly perceived.

At the cognitive level, closure may take many forms ranging from finding the answer to a simple factual question to solving an abstract mathematical or philosophical problem. It may be synonymous with insight, or, if premature, it may prevent insight from occurring.

At the psycho-motor level, closure is exemplified by such diverse phenomena as fitting pieces of a jig-saw puzzle together or blending sounds together to make up words.

This general use of a theoretical concept may be considered both as a strength and as a weakness. It allows many different aspects of behavior to be viewed within a unifying frame of reference. As such it has great heuristic value. On the other hand, in trying to encompass too much with one general concept we may be lacking in rigor and precision. We might be well advised to follow the advice of the General Sematicists and use the term "closure" with subscripts to differentiate its meaning in varying contexts. In other words, "closure$_1$" is not "closure$_2$."

Previous Experience

Gestalt psychologists have tended to look upon the laws of organization (including closure) as innate, primitive organizing tendencies in the nervous system which do not depend upon past experience. They presumably recognize the influence of past experience but tend to de-emphasize its importance. Some writers have made a distinction between primitive or naive closure which is not dependent upon previous experiences and closure which operates under the guidance of learned concepts. Sells (46), for example, makes a distinction between simple closure (e.g., filling in gaps in a circle) and "normalizing" which is described in the following quotation:

> The primary mechanism of closure takes on greatly expanded significance after the individual has learned many percepts. Then he not only completes broken, incomplete, or ambiguous figures toward symmetry, but also normalizes them by perceiving them as figures or objects he knows, expects, and desires . . . (p. 193)

Munn (33) uses the term "redintegration" to cover the learning process by which "parts of situations come to elicit the same response formerly aroused by the entire situation." (p. 322) His examples of "redintegration" parallel those which others have used as examples of closure.

Studies by Leeper (28), Bruner and Minturn (9), Bruner and Wechsler (10), and Postman and Bruner (38) clearly demonstrate that closure is influenced by previous learning and that the *Gestalt* principles of perceptual organization have been stated in too general a form. Although the theoretical distinction can be made between primitive closure and closure under the influence of previous learning, this distinction is seldom made in the research literature on closure.

Neurological Theory

Attempts have been made to account for closure in terms of hypothetical neurological processes. *Gestalt* psychologists postulate an "isomorphism" (i.e., identity of form) between phenomenal *gestalten* and physiological configurations within the nervous system. The flavor of this type of speculation is revealed in the following quotation from Woodworth (66):

> This tendency to cloze a gap is regarded as revealing a fundamental principle of brain dynamics; a tendency of the brain activity to bridge a gap, like the tendency of an electric current to jump a small gap in the circuit. Tension is built up on both sides of the gap. With the gap present there is a state of unbalanced tensions, but closure brings equilibrium. The sensory brain activity tends toward equilibrium or minimum tension, just as other continuous physical systems do--drops of water, soap bubbles, or electric currents. (p. 130)

This theorizing has a superficial plausibility, but after reviewing research in this area, Allport (2) came to the following conclusion: "It seems, therefore, that the gestaltists' efforts to find a satisfactory physiological correlate for their highly developed phenomenological system, and more particularly their hope of sustaining an isomorphic postulate by means of a neurological field-theory, have not yet been fulfilled." (p. 137)

A more recent attempt to account for a type of closure involved in reading (i.e., auditory blending) in terms of a neurological model has been made by Smith and Carrigan (48). The authors maintain that separate sounds in words can be integrated only if the neural activity aroused by separate word parts continues until all parts are reverberating simultaneously so that blending can occur. They offer a chemical "synaptic transmission" theory to account for this and other types of closure involved in reading.

Earl F. Rankin, Jr.

Information Theory

In the description of the cloze procedure, we saw that this technique could be conceptualized in terms of both "closure" and "information." We might therefore expect the concepts of closure and information to be related. Such is the case. As you will remember, closure is a special case of the law of Prägnanz (i.e., the tendency of psychological organization to move toward a "good Gestalt"). Attneave (3) maintains that the "good Gestalt" is a figure with a high degree of internal redundancy (i.e., a low degree of information) and that the Gestalt laws of organization (which include the law of closure) all refer to conditions which reduce uncertainty. He maintains that the human brain cannot utilize all the information provided by patterns of stimuli which are not highly redundant. Therefore, an important function of perception is to encode incoming information in a form more economical than that in which it impinges on the receptor organs. By closing gaps in a structure, we overlook irregularities (i.e., reduce uncertainty) and organize the remaining portions of an incomplete figure in a more economical form than that which impinges on the receptors. Information is greater at gaps in a structure, and perception functions to decrease this uncertainty by filling in the gaps, thereby forming a more stable (i.e., redundant) figure.

Research on Closure

Closure Factors

In 1931 Street (53) constructed the Street Gestalt Test to measure closure. The test consisted of 15 mutilated black and white pictures constructed so that it is necessary to bring about a closure in order to recognize the pictures. He administered this test together with a sentence completion test, a dissected sentence test, a dissected words test, and an intelligence test to students in elementary school and high school. He found no relationship between the Street-Gestalt Test and either the intelligence test or the verbal closure tests. The verbal closure tests, in contrast, correlated significantly with the intelligence test. He concluded that there were two closure factors--a pictorial factor and a verbal factor.

Thurstone (58) performed a factor analysis of 40 perceptual tests and found a visual closure factor and another factor which he described as flexibility in manipulating several irrelevant or conflicting gestalten. In a subsequent factor analysis made in 1949, Thurstone (59) found two factors which he now identified as "c_1--speed of closure" and "c_2--strength (or flexibility) of closure." The speed of closure factor was measured by such tests as the Street-Gestalt and Mutilated Words tests. It was measured by tests in which the perceptual field was initially disorganized and in which the subject had to unify the field. The flexibility of closure factor was measured by such tests as the Gottschaldt Figures. This test requires the subjects to find the one of five outlines of a simple figure that is embedded within a more complex design. Such tests require the ability to manipulate two configurations simultaneously or in succession and to shake off one set in order to take on a new one. To quote Thurstone, "The first closure factor c_1 seems to facilitate the making of a closure of an unorganized field; the second closure factor c_2 seems to facilitate the retention of a figure in a distracting field." (p. 17)

Other investigators have found similar closure factors. Before Thurstone's 1949 factor analysis (59), Rimaldi (42) had found a factor similar to flexibility of closure and Meili (29) had found two factors corresponding to speed and flexibility of closure. Subsequent to Thurstone's 1949 analysis, Botzum (8) and Adkins and Lyerly (1) found both speed and flexibility factors.

In addition to the two perceptual factors, Bechtoldt found a speed of ideational closure factor with verbal materials. Pemberton (36) also found a verbal closure factor in addition to the speed and flexibility factors. Mooney (31) performed a factor analysis on six closure tests and found 5 factors: (1) verbal closure, (2) cognitive rigidity (similar to "flexibility of closure"), (3) conceptual closure, (4) formal reasoning, (5) perceptual closure (similar to speed of closure). The formal reasoning factor was clearly marked off from the others.

In summary, it appears that many investigators have found a speed of closure factor and a flexibility of closure factor. In addition, several studies have revealed a separate closure factor involving verbal concepts.

Closure and Cognition

Thurstone (59) hypothesized that speed of closure might be related to inductive thinking and flexibility to deductive thinking. Regarding speed of closure, Street (53) found no relationship to intelligence, Botzum (8) found it to be unrelated to either inductive or deductive reasoning, Adkins and Lyerly (1) found that it did not transcend the visual modality, Pemberton (36) found a slight correlation (.24) with deductive reasoning, and Mooney (31) found it to be unrelated to formal reasoning (deductive). Botzum (8) and Bechtoldt (5) found it to be negatively related to a number factor, and Wilson et. al. (64) found it to be negatively related to an originality measure and found no relationship to flexibility measures in creative thinking.

Regarding flexibility of closure, Thurstone (59) found it loaded on a composite reasoning score for Primary Mental Abilities; Yela (67) obtained a .59 correlation with a reasoning factor; Botzum (8) found induction, deduction, and flexibility of closure on a second-order factor interpreted as an "analytic" factor; Adkins and Lyerly (1) found "most of the tests loaded on this factor are also loaded on other factors that seem to fall within the realm of reasoning"; and Pemberton (36) obtained a strong relationship with deductive reasoning and a slight negative relationship to synthetic reasoning. In contrast to other findings, Mooney (31) found his formal reasoning (deductive) clearly marked off from "cognitive rigidity" which, according to the author, is similar to flexibility of closure. White (63) suggests that this factor may be of central importance in a wide variety of behaviors and suggests a redefinition to free it of its specifically perceptual connotations.

In summary, it seems that Thurstone's hypothesis regarding speed of closure being related to inductive reasoning has not been supported by subsequent research. In fact, speed of closure appears to be generally unrelated to reasoning and flexibility in creative thinking and negatively related to numerical thinking and originality. On the other hand, there is ample evidence to support Thurstone's contention that flexibility of closure is related to deductive reasoning. In fact, the relationship of flexibility of closure and reasoning is so strong that there is some question as to whether or not this should be termed a strictly "perceptual" factor. It appears to partake of both perceptual and cognitive elements, while speed of closure is a relatively pure perceptual factor.

Closure and Personality

There has been a considerable amount of work done on the relationship between personality variables and closure. Street (54) found that psychiatric patients performed better on the Street-Gestalt Test than normal adults. Roseman (44) compared normal and psychiatric patients on a jig-saw puzzle closure-behavior test, and concluded that the greater the personality disorganization, the lower the frequency of closure behavior.

Frenkel-Brunswik (15) postulated "intolerance of ambiguity" as a personality trait which is manifested not only in social and emotional areas but also in perception and cognition. She implies that some people have a tendency to form clear-cut Gestalten which are closed and difficult to modify. Such people are characterized by premature closure and the rigid perseverance of old configurations. Prejudice is presumably related to intolerance of ambiguity. She compared perceptual responses to ambiguous pictures of children who were high and low in prejudice, and she found the prejudiced children held on longer to their initial perceptions as a series of pictures changed gradually from a picture of a dog to that of a cat. Rokeach (43) compared rigidity in problem solving among children with high and low prejudice, and found prejudiced children maintained their original set longer after they were given a simpler and more direct method of solving a problem. Smock (52) hypothesized that anxiety is a determinant of intolerance of ambiguity, and found that subjects who made decisions either relatively early or relatively late on a Decision Location Task showed shorter latency of responses on a speed of closure test than the group who made decisions in the middle portion of the task series. Both early and late decisions were interpreted as being due to anxiety. Douglas (14) found a correlation between an authoritarianism scale and a strength of closure test. Taylor (55) found extreme liberals and conservatives on social attitudes showed no differences in degree of closure but both showed significantly greater closure tendencies than the intermediate group in social attitudes.

On the other hand, Davids (12) found no relationship between authoritarianism and tolerance for ambiguous visual or auditory stimuli. The author mentions several different negative findings by other investigators (not reviewed in the paper) concerning predictions made from the theory of the authoritarian personality. Guilford (20) states that rigidity is an ill-defined concept. He says,

> ...it has been used broadly to describe stereotyped or persistent behavior in many areas, including perception, thinking, motor behavior, and even attitudes. Scattered studies have tended to show, however, that rigid behavior in one of these areas is not necessarily correlated with rigid behavior in others. It is very unlikely, therefore, that there is a single common factor of rigidity. (p. 387)

Pemberton (37) studied temperamental characteristics as a function of speed of closure and flexibility of closure. He found that subjects who were high in speed of closure had the following characteristics: sociability, self-confidence, quick reactivity, artistic interests, systematic and neat, and interested in doing more than thinking. Subjects high on flexibility of closure were characterized by the following traits: socially retiring, independent of other's opinions, analytical, interested in theoretical and scientific problems, dislike routine and tidiness, and think of consequences before acting. The lack of sociability of subjects high in flexibility of closure suggests that they are able to detach their egos from the outside world. This interpretation is supported by the findings of Smith (50) and Witkins (65). Smith found that subjects who scored high on the Gottschaldt Figures Test (measures flexibility of closure) were socially retiring. Witkins found that subjects scoring high on the Gottschaldt Figures were able to ignore the visual clues of a tilted room and to rely on their own body sensations to determine vertical orientation. The theoretical orientation of high flexibility of closure individuals is supported by the studies of Gehlmann (16) and Jay (22). Gehlmann found a significant correlation between Gottschaldt Figures scores and interest in physical science. Jay found a positive relation between the same test and the theoretical score on the Allport-Vernon Scale of Values.

There are several bits of evidence concerning the influence of emotional and motivational states on closure. Verville (61) found that situationally induced sets of tension, failure and frustration, etc., had significant effects on the perception of incomplete figures. Korchin and Basowitz (27) found the ability to see openings in circles was influenced by stress set up by parachute jumping practice. Smock (51) discovered that stress tends to result in increased intolerance of ambiguity. Moffitt and Stagner (30) found a relationship between situationally induced anxiety and closure but failed to find a similar relationship between manifest anxiety and closure. Dittes (13) found that situationally induced threat to self esteem resulted in greater "impulsiveness of closure" in making complex judgments.

In summary, there is little doubt that psychiatric illness and closure are related although the dynamics are not understood. There is conflicting evidence regarding the generality of premature closure and rigidity in the "intolerance of ambiguity" syndrome. Some clear-cut personality differences have been found between subjects who excel on speed of closure and those who do well on flexibility of closure. And, finally, closure is apparently influenced by stress and anxiety.

Age and Sex Differences in Closure

In the initial standardization of the Street-Gestalt Test, Street (53) gave the test to third grade, sixth grade, and high school students and found no age differences. Street's results on the standardization study prompted Thurstone (58) to say that the finding was of interest because it indicated the test involved factors which mature at an early age and it may be taken as an indication of some primitive function. Verville and Cameron (62) compared age and sex differences in closure among adults ages 16-23 and 35-56 and found no age or sex differences other than speed of reaction time in favor of the younger subjects. However, as Mooney (32) pointed out, Street had eliminated items which showed age differences in standardizing his test, and Verville and Cameron's study was limited to adults, used only ten items, and included percepts which could not be assumed to be of equal familiarity to all subjects. Mooney (32) studied the relationship between closure and age under conditions which minimized differences in perceptual experience and social and educational background. He gave closure tests to children in grades 2-8 and to a group of adults. He found no sex differences, but obtained a constant and significant association between closure and age. Basowitz and Korchin (4) compared speed of closure and flexibility of closure between a group of young adults (mean age 26.8) and a group of old adults (mean age 78.1). They found the older group inferior on both tasks. The older group displayed lessened integrative ability and excessive cautiousness.

Shopshire (47) compared seventh grade boys and girls on five tests of closure and found the girls excelled on four of the five closure measurements.

In summary, despite early indications that there are no age differences in closure, more recent studies have found age differences over a wide span of years. No clear pattern of evidence has emerged regarding sex differences.

Bender-Gestalt Studies

The Bender-Gestalt Test is a test of psychomotor ability which involves copying various types of figures. Guertin (18) performed a factor analysis of Bender-Gestalt results for hospitalized mental patients and found six factors, including a "propensity for curvilinear movement." The non-closure of elements is important in this factor. Guertin believes that underlying this factor is poor emotional control which makes it difficult to maintain a Gestalt once it is formed. In a factor analysis of curvilinear distortions on the Bender-Gestalt, Guertin (19) found an "unstable closure" factor. The highest loading on this factor was for catatonic schizophrenics, and a negative loading was found for hebephrenics. Pascal and Suttell (35) found inability to integrate parts into wholes on the Bender-Gestalt to be related to learning problems among children. Byrd (11) found the "closure difficulties" score of the Bender-Gestalt to be one of four scores which differentiated maladjusted boys (8-16 years old) from normal boys of a similar age.

Harriman and Harriman (21) compared Bender- Gestalt results of five year old children who had not learned to read with seven year old children who were making satisfactory progress in reading. They found the readers performed better in several categories (including closure) than the non-readers. Koppitz (25) compared Bender-Gestalt results of children whose achievement in reading, writing and spelling was above average with children whose achievement in these areas was below average. She found seven categories which differentiated the two groups, and one of the categories was "failure to integrate parts into wholes." Keller (24) and Koppitz, Sullivan, David, and Shelton (26) report correlations between Bender-Gestalt total scores and reading ability, but no data on closure are given.

In summary, the Bender-Gestalt Test measures closure, among other things, and the closure scores on this test appear to be related to reading ability.

Earl F. Rankin, Jr.

Closure and Reading

Regarding the relationship between reading and closure, Thurstone (58) states:

> Reading seems to involve a form of closure, and it is a reasonable guess that there are temperamental differences among people in the assurance that they demand in the reading process. Some readers are able to form an acceptable closure over a wide span without actually perceiving all the detail. A part of the difference between fast and slow readers may be attributable to the subjects' willingness or unwillingness to accept a closure over a wide span that seems plausible even though he does not have the perceptual assurance that the closure is correct. (p. 12)

Thurstone compared fast and slow college age readers on a number of perceptual tests but failed to find significant differences between slow and fast readers on the closure tests. Shopshire (47) studied the relationship between closure and reading among seventh grade pupils and found a significant correlation between closure and reading for boys but not for girls. Goins (17) found strength of closure (i.e., Thurstone's flexibility of closure) to be significantly related to reading at the end of the year among first graders, but found the Street-Gestalt (i.e., speed of closure) to be unrelated to reading skill at the end of the year. She found several closure tests to be a better prediction of reading than standardization intelligence tests, and she recommended the inclusion of visual closure tests in readiness test batteries. Smith (49) performed a factor analysis of test results of poor readers among children and found several factors including a closure factor. He found particular combinations of factors identified different types of reading problems such as "low speed and closure with high memory and accuracy" and "high speed and closure with low memory and accuracy." Suggestions were made for dealing with such types of reading problems.

In summary, limited evidence indicates that closure may not be related to reading speed at the college level but is definitely related to reading skill among children.[3] More research is needed in this area.[4]

---

[3] R. R. Geake found a substantial relationship (r=.50) between gain in reading speed and Thurstone's Mutilated Words Test when speed was measured fifteen weeks following a reading course for high school students (Differences in Reading Rate Improvement between Slow and Fast Readers, etc., unpublished dissertation, The University of Michigan, 1962).

[4] For persons interested in carrying out research on closure and reading, Mooney and Ferguson (1959) have devised a new group closure test which can be obtained for experimental purposes from the Department of Psychology, McGill University, Montreal, Quebec. Also Moran and Mefferd (1959) have devised tests of speed and flexibility of closure for longitudinal studies. There are 20 alternate forms which require less than 3 minutes to administer. These tests can be obtained for experimental purposes by writing Hogg Foundation for Mental Health, University of Texas, Austin, Texas.

Earl F. Rankin, Jr.

Closure and the Close Procedure

We shall now consider the cloze procedure in the light of the foregoing review of research on closure. Any conclusions regarding closure and the cloze procedure may be applied to closure and the reading process: guessing the missing words from context in the cloze technique is analogous to (although not identical with) the reading situation where the reader is confronted with a new word, in context, of unknown or uncertain meaning. Our question is, how is closure involved in this type of reading situation and what factors influence it?

First, let us consider types of closure (i.e., perceptual, cognitive, and motor) which may be involved in making cloze responses (i.e., filling in gaps in a printed message). Although the evidence is limited, there is some doubt that visual closure is involved in the cloze procedure--at least for most readers. Sentence completion tests bear a close resemblance to the cloze procedure and Street (53) found no relationship between the Street-Gestalt and a sentence completion test among children. Botzum (8), using college students as subjects, found no relationship between a sentence completion test and either the speed of closure or the flexibility of closure factors. Several investigators have found a closure factor for dealing with verbal materials as distinct from visual closure factors. All of this suggests that making cloze responses is primarily a cognitive rather than a perceptual task. The speed of visual closure factor would not appear to be involved because (a) the gaps are not actually seen as filled before the correct word is written in the blank space and

(b) the remaining parts of the sentence cannot be organized as a complete configuration until the correct word is cognized. It may be that very young children (or older children with intellectual deficiencies) might make cloze responses utilizing flexibility of closure which appears to partake of both perceptual and cognitive elements. This factor involves the ability to hold in mind a perceptual Gestalt while at the same time manipulating parts of the whole. Insofar as cloze responses are attempted at a visual perceptual level, flexibility of closure should facilitate the testing of various hypotheses regarding the words that "look right" in the blank spaces in the message context. Reading, as we know, is primarily a perceptual task for young children, whereas it becomes more of a cognitive task with increasing age. For older readers, decisions regarding cloze responses are more likely to be made in terms of what "makes sense" rather than what "looks right". Therefore, for most readers, the cloze procedure probably involves cognitive more than visual closure.

At the cognitive level, closure may range from an instantaneous "aha!" experience to a fully conscious logical evaluation (e.g., "If I put this word in the blank space, the sentence makes sense in relation to the whole paragraph.")

Auditory-motor closure may be involved if the word to be filled in the blank space is vocalized or sub-vocalized. In such a case, the separate sounds which make up the word must be blended together. This could be done at the level of auditory imagery or vocal blending or both. On the other hand, it is possible to cognize the meaning that fills the gap directly without any vocalization or subvocalization, in which case the only motor closure involved would occur as one writes the word in the blank space.

Closure failure may occur at one or more behavioral levels--perceptual, cognitive or motor. These types of closures are not necessarily related. For example, it is possible to "see" the word that fits the context without being able to pronounce it, or to be able to vocalize a word without fully understanding its meaning, or to understand the meaning required by the context without being about to write the word.

Personality factors may influence cloze responses in many ways. Insofar as "intolerance of ambiguity" is a valid concept, it may be that rigid personalities would tend toward premature closure in making cloze responses and rigidly maintaining an initial set when it is incorrect. To such persons, the ambiguity inherent in a mutilated verbal passage may be extremely unpleasant or even threatening.

Impulsivity would also tend to bring about premature closure in making cloze responses. Rankin (39) found that extroverts (who tend toward impulsivity) made such erratic responses to the cloze technique that one form of a cloze test was relatively unreliable and invalid for them as a measure of reading comprehension. On the other hand, the reliability and validity of this cloze test for introverts was significantly higher. In addition, as might be expected, the introverts made significantly higher mean scores than the extroverts.

The social context in which the cloze responses are made should influence closure. If the situation is threatening to the self-esteem of the respondent, premature or delayed cloze responses may be the result. The level of manifest anxiety of the reader may also influence cloze responses. Rankin (39) found one of several equated forms of a cloze test was threatening to readers with a high anxiety level. This was attributed to the initial difficulty of the items in the form of the cloze test which caused readers with high anxiety to make lower scores.

Age differences should also influence cloze responses, not so much because of increased visual closure ability but due to more mature cognitive functioning and the effects of learning influencing the "normalizing" (see Sells) and "redintegration" (see Munn) processes. Through increased learning ability and accumulated experience, people learn to bring about closure under the guidance of learned percepts and to respond more adequately to reduced clues.

Perhaps this paper will help to bring about some "closure" in the mind of the reader concerning the concept of closure and its relationship to the cloze procedure and the reading process.

Earl F. Rankin, Jr.

REFERENCES

1. Adkins, D. C., and Lyerly, S. B. Factor Analysis of Reasoning Tests. Chapel Hill, University of North Carolina Press, 1952.

2. Allport, F. H. Theories of Perception, and the Concept of Structure. New York: John Wiley and Sons, 1955.

3. Attneave, F. "Some Informational Aspects of Visual Perception," Psychological Review, 1954, 61, 183-198.

4. Basowitz, H., and Korchin, S. J. "Age Differences in the Perception of Closure." Journal of Abnormal and Social Psychology, 1957, 54, 93-97.

5. Bechtoldt, H. P. "Factorial Study of Perception Speed." Unpublished Ph.D. dissertation, University of Chicago, 1947.

6. Bloomer, R. H. "The Cloze Procedure as a Remedial Reading Exercise." Journal of Developmental Reading, 1962, 5, 173-181.

7. Bobbitt, J. M. "An Experimental Study of the Phenomenon of Closure as a Threshold Function." Readings in Perception, Beardsley, D. C. and Wertheimer, M. New York: D. Van Nostrand Co., Inc., 136-159.

8. Botzum, W. A. "A Factorial Study of Reasoning and Closure Factors." Psychometrika, 1951, 16, 361-386.

9. Bruner, J. S. and Minturn, A. L. "Perceptual Identification and Perceptual Organization." Journal of General Psychology, 1955, 53, 21-28.

10. Bruner, J. S. and Wechsler, H. "Sequential Probability as a Determinant of Perceptual Closure." *American Journal of Psychology*, 1958, *71*, 604-606.

11. Byrd, E. "The Clinical Validity of the *Bender-Gestalt Test* with Children: A Developmental Comparison of Children in Need of Psychotherapy and Children Judged Well-adjusted." *Journal of Projective Techniques,* 1956, *20*, 127-136.

12. Davids, A. "Some Personality and Intellectual Correlates of Intolerance of Ambiguity." *Journal of Abnormal and Social Psychology*, 1955, *51,* 415-420.

13. Dittes, J. E., "Effects of Changes in Self-Esteem Upon Impulsiveness and Deliberation in Making Judgments." *Journal of Abnormal and Social Psychology*, 1959, *58*, 348-356.

14. Douglas, W. G. "Some Perceptive Correlates of Authoritarianism." Unpublished Ph.D. dissertation, Temple University, 1957.

15. Frenkel-Brunswik, E. "Intolerance of Ambiguity as an Emotional and Perceptual Personality Variable." *Journal of Personality*, 1949, *18*, 108-143.

16. Gehlmann, F. "Performance on Objective Tests as Indicators of Temperament and Other Personality Traits." Unpublished Ph.D. dissertation, University of Chicago, 1951.

17. Goins, J. T. "Visual Perceptual Abilities and Early Reading Progress." *Supplementary Educational Monograph*, 1958, No. 87.

18. Geurtin, W. H. "A Factor Analysis of the Bender-Gestalt Tests of Mental Patients." Journal of Clinical Psychology, 1952, 8, 362-367.

19. Guertin, W. H. "A Factor Analysis of Curvilinear Distortions on the Bender-Gestalt." Journal of Clinical Psychology. 1954, 10, 12-17.

20. Guilford, J. P. Personality. New York: McGraw-Hill Book Co., 1959.

21. Harriman, M., and Harriman, P. L. "The Bender-Visual-Motor-Gestalt Test as a Measure of School Readiness." Journal of Clinical Psychology, 1950, 6, 175-177.

22. Jay, R. L. "The Relation Between Some Perceptual Factors and Some Personality Categories." Unpublished M.A. Thesis, University of Chicago, 1950.

23. Jenkinson, M. E. "Selected Processes and Difficulties in Reading Comprehension." Unpublished Ph.D. dissertation, University of Chicago, 1957.

24. Keller, J. E. "The Use of a Bender-Gestalt Maturation Level Scoring System with Mentally Handicapped Children." American Journal of Orthopsychiatry, 1955, 25, 563-573.

25. Koppitz, E. M. "The Bender-Gestalt Test and Learning Disturbances in Young Children." Journal of Clinical Psychology, 1958, 14, 292-295.

26. Koppitz, E. M., Sullivan, J. B., David, D., and Shelton, J. "Prediction of First Grade School Achievement with the Bender-Gestalt Test and Human Figure Drawings." Journal of Clinical Psychology, 1959, 15, 164-168.

27. Korchin, S. J., and Basowitz, H. "Perceptual Adequacy in a Life Stress." Journal of Psychology, 1954, 38, 495-502.

28. Leeper, M. R. "A Study of a Neglected Portion of the Field of Learning." Journal of Genetic Psychology, 1935, 46, 41-75.

29. Meili, R. "L'analyse de l'intelligence." Archives de Psychologie, 1946, 31, No. 121, 1-64.

30. Moffitt, J. W., and Stagner, R. "Perceptual Rigidity and Closure as Functions of Anxiety." Journal of Abnormal and Social Psychology, 1956, 52, 354-357.

31. Mooney, L. M. "A Factorial Study of Closure." Canadian Journal of Psychology, 1954, 8 , 511-560.

32. Mooney, G. M. "Age in the Development of Closure Ability in Children." Canadian Journal of Psychology, 1957, 11, 219-226.

33. Munn, N. L. Psychology (3rd Edition). Boston: Houghton Mifflin Co., 1951.

34. Murphy, G. Personality. New York: Harper, 1947.

35. Pascal, G. R., and Suttell, B. J. The Bender-Gestalt Test. New York: Grune and Stratton, 1951.

36. Pemberton, C. L. "The Closure Factors Related to Other Cognitive Processes." Psychometrika, 1952, 17, 267-288.

37. Pemberton. "The Closure Factor Related to Temperament." Journal of Personality, 1952, 21, 159-175.

38. Postman, L., and Bruner, J. S. "Hypothesis and the Principle of Closure: The Effect of Frequency and Recency." Journal of Psychology, 1952, 33, 113-125.

39. Rankin, Jr., E. F. "An Evaluation of the Cloze Procedure as a Technique for Measuring Reading Comprehension." Unpublished Ph. D. dissertation, The University of Michigan, 1957.

40. Rankin, Jr., E. F. "The Cloze Procedure--Its Validity and Utility." Eighth Yearbook of the National Reading Conference. Fort Worth: The Texas Christian University Press, 1959.

41. Rankin, Jr., E. F. "Uses of the Cloze Procedure." International Reading Association Conference Proceedings. New York: Scholastic Magazines, 1959, 228-232.

42. Rimaldi, H. J. "A Study of Some Factors Related to Intelligence." Psychometrika, 1948, 13, 27-47.

43. Rokeach, M. "Generalized Mental Rigidity as a Factor in Ethnocentrism." Journal of Abnormal and Social Psychology, 1943, 48, 259-278.

44. Roseman, M. "Closure Behavior and Levels of Personality." Journal of Personality, 1952, 21, 48-58.

45. Schoenfield, N. "The Metaphor of 'Closure'." Psychological Review, 1941, 48, 487-497.

46. Sells, S. B. Essentials of Psychology. New York: The Ronald Press, 1962.

47. Shopshire, L. "An Investigation of the Relationship Between Some Properties of Closure and Reading Performance." Unpublished Ph.D.

dissertation, Syracuse University, 1955.

48. Smith, D. E. P., and Carrigan, P. The Nature of Reading Disability. New York: Harcourt, Brace and Co., 1959.

49. Smith, D. E. P. "The Perceptual Component in Reading." Unpublished manuscript, The University of Michigan, 1960.

50. Smith, F. E. "Word Reactions and Temperament." Unpublished Ph.D. dissertation, University of Chicago, 1951.

51. Smock, C. D. "The Influence of Psychological Stress on the 'Intolerance of Ambiguity'." Journal of Abnormal and Social Psychology, 1955, 50, 177-182.

52. Smock, C. D. "The Relationship Between 'Intolerance of Ambiguity,' Generalization, and Speed of Perceptual Closure." Child Development, 1957, 28, 27-36.

53. Street, R. F. "A Gestalt Completion Test. A Study of a Cross Section of Intellect." Teachers College Contributions to Education, 1931, No. 481.

54. Street, R. F. "The Gestalt Completion Test and Mental Disorders." Journal of Abnormal and Social Psychology, 1934, 29, 141-142.

55. Taylor, I. A. "Perceptual Closure and Extreme Social Attitudes." Unpublished Ph. D. dissertation, New York University, 1958.

56. Taylor, W. L. "'Cloze Procedure': A New Tool for Measuring Readability." Journalism Quarterly, 1953, 30, 415-433.

57 Taylor, W. L. "Application of 'Cloze' and Entropy Measures to the Study of Contextual Constraints in Samples of Continuous Prose." Unpublished Ph.D. dissertation, University of Illinois, 1954.

58. Thurstone, L. L. A Factorial Study of Perception. Chicago: University of Chicago Press, 1944.

59. Thurstone, L. L. Mechanical Aptitude III: Analysis of Group Tests. The Psychometric Laboratory, University of Chicago, Report No. 35, May 1949.

60. Tiernan, J. J. "The Principle of Closure in Terms of Recall and Recognition." American Journal of Psychology, 1938, 51, 97-108.

61. Verville, E. "The Effect of Emotional and Motivational Sets on the Perception of Incomplete Figures." Journal of Genetic Psychology, 1946, 69, 133-145.

62. Verville, E., and Cameron, N. "Age and Sex Differences in the Perception of Incomplete Pictures by Adults." Journal of Psychology, 1946, 68, 149-157.

63. White, B. W. "Visual and Auditory Closure." Unpublished Ph. D. dissertation, The University of Michigan, 1953.

64. Wilson, R. L., Guilford, J. P., Christensen, P. R., and Lewis, D. J. "A Factor Analytic Study of Creative Thinking Abilities." Psychometrika, 1954, 19, 197, 311.

65. Witkins, J. A. "The Nature and Importance of of Individual Differences in Perception." Journal of Personality, 1949, 18, 145-170.

66. Woodworth, R. S. Contemporary Schools of Psychology. New York: The Ronald Press Co., 1948.

67. Yela, M. "Application of the Concept of Simple Structure to Alexander's Data." Psychometrika, 1949, 14, 121-135.

READING AS INFORMATION PROCESSING

Carl Semmelroth
University of Michigan

To define reading as information processing avoids many problems of epistemology. When one asks, "What is reading?", he may mean, "What behavior does one ordinarily refer to when he uses the word, 'reading'?" The answer requires specification of the behaviors named reading and those which are not so named. This kind of answer is called definition by ostension.

Another kind of answer to the question is called definition by intension. It is usually rather crude and unsatisfying: "Reading is getting meaning from printed material." Such definitions strain friendships and usually end, "Well, you know what I mean," followed by, "But I don't and that's just the point."

Let me offer a third kind of definition: Reading is information processing.

Because of the above considerations, I hasten to add some qualifications. (1) I do not intend the definition in the ostensive sense, i.e., not all information processing tasks are reading tasks. (2) Neither is it simply intended as a description of reading. As a description it is both obvious and trivial. (3) It does not carry the intent of ordinary usage. As such, it would be both incomplete and inappropriate.

Nevertheless, it is a definition in a very strict sense. It says "Reading is information processing," not "acts like," "looks like," or "involves," but is. Thus, for purposes of this paper, I wish to treat information processing as being identical with the reading process.

In brief, this is definition by postulation. This sort of initial definition is characteristic of model building. It is a way of removing a term (such as "reading") from the morass of meanings, connotations, and implications of ordinary usage and giving it a highly discreet and unequivocal definition. This kind of maneuver cannot, of course, do justice to the "meaning" of the term. However, it can furnish us with a logico-deductive framework from which we may draw certain conclusions, and possibly, insights. The problem of evaluating the definition becomes one of ascertaining the model's usefulness for answering questions about the process defined.

Information Processing Defined

"Information processing" is used here in a restricted and technical sense. "Information" is intended in the sense used by Shannon and Weaver (1). They were interested in developing a mathematical language for quantifying certain aspects of communication by electronic systems. The method is often referred to as information theory. In fact, it is neither a theory nor does it concern information in the ordinary sense. Rather, it is a method for calculating a quantity which Shannon originally called "entropy," and which more recently has come to be called "uncertainty." Thus, perhaps a more descriptive name for "information theory" is "a method for uncertainty analysis." The mathematics of Shannon's method is not important for our present purposes. However, his concept of "information" as "uncertainty" is of interest because it forms the basis of our model definition, information processing.

Information defined. The concept of information as used in uncertainty analysis is best illustrated by example. Someone chooses a word at random, from a book chosen at random, from a large university library. Then he asks you to guess the first letter of the word. If all letters occurred with equal frequency in the language, your chances of choosing the correct letter would be 1 in 26. Your uncertainty in this situation would be quite high in the ordinary sense of "uncertainty." However, all letters do not occur with the same frequency. You are given a table which lists the relative frequency or probability of occurrence of each letter in written English. In this table, you note that there is a large variation in the relative frequency of different letters running from e (1 in 8 times) to z (less than 1 in 1,000). Given this data, your chances of guessing the correct letter would be better than 1 in 26. Thus, in a sense, the table of letter frequencies has resulted in a decrease in your uncertainty about being correct on any guess, even though you still don't know and haven't tried to guess the letter. To this point, I have been using "uncertainty" in its ordinary sense. Now let us consider the meaning of uncertainty (information) in this situation in the context of information theory.

In the given case, (guessing 1 of 26 letters with equal probabilities), the uncertainty ($\hat{H}$) is a characteristic of the situation, and can be calculated as a quantity (4.7 bits)[1]. The method of calculating this quantity is not of importance to us here, but what it reflects is of interest. It is probably best described as average uncertainty. It represents how much information, on the average, would be gained by guessing one of each of the 26 letters, each trial, over a great many trials.

The concept of how much could be gained by guessing is the key. How much could be gained on the average by guessing in some sense reflects the amount of disorganization in the situation. In the present example, on the average you would be wrong 25 out of 26 times, i.e., most of the time. This reflects considerable uncertainty, informatiion or disorganization. If the situation were such that you were right every time, this would reflect complete organization, hence no uncertainty, hence no information.

---

[1] $\hat{H} = \log_2 A$, where A equals the number of equally likely alternatives.

It is this sense of uncertainty, amount of disorganization, which is the basis of information theory. As a mathematical quantity it has two important characteristics:

1. It reaches a maximum when all of the alternatives in a situation have equal probability of occurrence. This would be the case for guessing 1 of 26 letters if their relative frequencies were equal. ($\hat{H} = 4.7$, the highest value for a set of 26 alternatives.) Thus, if there is any information or regularity in the data, some probabilities are increased while others are decreased and $\hat{H}$ is reduced. In the case where we take into consideration the relative frequencies of letters in written English, $\hat{H}$ drops to 4.1.

2. The second characteristic of $\hat{H}$ is that it increases as the number of possible[2] alternatives increases. Thus, if there were 32 equally likely alternatives instead of 26, $\hat{H}$ would increase from 4.7 to 5.0.

Implications. We are now in a better position to interpret the definition of reading as information processing. The term "information" now takes on an unequivocal meaning, i.e., it is to be identified with the conception of information or uncertainty as used in information theory. Before addressing the problem of specifying what "processing" is to mean in the definition, it is necessary to point out some implications of viewing reading as involving uncertainty. These implications are derived directly from the two properties of the information ($\hat{H}$) measure cited above. First, since $\hat{H}$ varies with the number of alternatives, those alternatives must be in the repertoire of the individual. Second, since $\hat{H}$ varies with the probabilities of occurrence of the alternatives, these probabilities must in some sense be programmed in the reader. My use of "information processing" as a model definition requires that I argue the reasonableness of the implications I draw. In doing so for the first implication above, I will lay the groundwork for a distinction between two senses of "processing." In this way, specification of the meaning of "information processing" as it is used in the definition will be completed.

---

[2] $\hat{H} = -\Sigma p(i) \log_2 p(i)$ for the case of unequal alternatives; where p(i) is the probability of occurrence for an individual alternative (letter).

Processing defined. I have contended that alternative responses must be available for reading to occur. Our meaning of the term "information" demands that these alternatives exist at the time of the reading act, as discrete alternatives in the system, not just as logical possibilities. I am going to argue that it is reasonable to conceive of these alternatives as relatively discreet neural circuits which may be active concurrently. Such a condition seems to be required to account for the process of visual perception. Let me illustrate.

Psychology traditionally makes a distinction between perception and sensation. This distinction is often blurred for the reason that we have no access to experiences of sensations except as percepts. Hence, we are unable to point to anything in our phenomenal experience and say that it is a sensation and not a percept. Nevertheless, the distinction may still be made by examining the sensory apparatus itself as well as certain perceptual phenomena.

Carl Semmelroth

There is a set of phenomena referred to as "perceptual constancies." For example, when one views a rectangular object such as a book cover from several different angles, one still sees a rectangular book cover. This is the case, even though the sensory image on the retina varies a great deal when one changes his angular relation to the book. That is, the visual image on the retina may be a parallelogram with extreme angles, and yet we "see" or perceive an ordinary rectangular book cover. Consider also some facts about the visual apparatus itself. The eye is often thought of as being analogous to a camera in its operation. The camera analogy is helpful for some purposes, but it can also be very misleading. Whereas an image can be focused clearly on the film in a camera, this is not the case in the eye. If we were able to take the retina, while the eye is fixated on some object, and develop it as we can a photographic film, the resulting picture would not begin to approach the clear, well-defined photograph of a camera. Our appreciation of the primitive state of the visual sensation is further enhanced by considering the organization of the visual receptors in the retina.

The receptors themselves are not only facing away from the direction from which the light is coming, but they are covered by several layers of translucent cells consisting of nerve fibers and ganglion cells of several sizes and types. The picture is further complicated by their distribution. An area in the center of the visual field, smaller than the size of a penny held at arm's length, is the only place where precise pattern discriminations can be made. This area of the retina (less than 35 minutes of visual arc in diameter) contains an immense number of visual receptors (cones), but from there on out, they drop off quickly in number. Furthermore, those in the periphery must share nerve fibers so that they are less able to sense fine spatial differences in stimulation.

Carl Semmelroth

If the eye were always perfectly stationary, only that part of the image which falls on this tiny central portion could be "seen" clearly. For this reason, it is indeed fortunate that the eyes are capable of moving with such speed and precision. But these movements themselves present a puzzling problem. That is, we perceive stable objects in the world, and yet the sensory image is jumping around from position to position on the retina.

Considerations such as these lead one to a growing appreciation that the perceptual process must involve more than a simple passive identification of sensory events. The events of sensation by themselves are just not capable of accounting for the high degree of constancy, clarity and organization present in our percepts.

For this reason, it is plausible to conceptualize the perceptual process as being much more "centrally" determined than a common-sense notion suggests. (The common-sense notion has the perceiver as a kind of receiver of information.) This suggestion goes further than the so-called "new look" at perception which has come about in psychology. What is suggested here is not just that internal states such as motives or need affect perception. Rather, it is suggested that previously existing internal states of the organism are responsible for perception.

The concept of "information" in our model definition may now be further clarified. It has been previously identified as the amount of disorganization contained in a situation involving a number of discreet alternatives. One property which affects the amount of disorganization (information, uncertainty) is the number of alternatives present. Thus, our model of the reading process may be stated: Reading is the processing of a number of previously existing states of the organism. These states are not seen as being brought about by the presently existing sensory stimulation, i.e., the presence of the words or letters on the page, but rather they are seen as being the neural activity present while the sensory events are being initiated.

The information being processed in reading is within the person, not on the page, or on the retina. The page may be a necessary condition for this processing to take place, but it is not a sufficient condition. In order for reading to take place in terms of the present definition, there must also be a state of uncertainty existing within the person. Further, the processing of this uncertainty (in the presence of the print) is exactly what is meant by our definition of reading. It does not mean that if uncertainty is present it will be processed when reading takes place; rather, it says reading cannot take place unless uncertainty is present.

Now we may distinguish between two ways in which information (uncertainty) may be thought of as being "processed". If the information exists in the form of alternative internal states, these states may be most easily conceptualized as simultaneously firing neural networks. In one sense then, processing of information could refer to the "choice" of one of these networks through the interaction of sensory stimulation (looking at the word on the page) and the operation of the active networks. This process can be seen as a matching between the sensory input and the appropriate network firing. It, of course, assumes that one of the networks firing will in fact be an appropriate match for the sensory stimulation. This condition may fail to be met in either of two ways:

1) An appropriate network may never have been formed. This would be the case when one comes across a word never seen before.

2) The appropriate network may not be active. This would be the case when the reader's attention lapses during reading.

Thus another sense of processing may be distinguished: the initiation of firing in appropriate networks so that matching can take place. This is to be distinguished from the process of forming these networks in the first place which falls under the heading, learning to read.

To summarize, the definition of reading as information processing, with the appropriate specification of terms, leads us to a model of the reading process which yields several distinctions and implications:

1) Reading is the processing of "uncertainty" which exists in the person, not on the page.

2) This uncertainty exists (if it exists) in the form of active alternative states within the individual.

3) Reading cannot take place unless these alternatives are present.

4) Reading cannot take place unless these active alternatives are appropriate with respect to the material to be read.

This model may also provide us with some insight into the operation of methods which are commonly used to improve reading skill. When you coax a student to form questions before attempting to read a passage, you are attempting to stimulate some uncertainty in him. This is also true of surveying and skimming before reading. Furthermore, processing his uncertainty requires that it be relevant to the material constituting the stimulus array, i.e., the page. Therefore, his questions must continually be revised to fit the passage.

Carl Semmelroth

In a general qualitative sense, the model pictures reading as a very active, goal-oriented behavior, not a passive stimulation by the print.

The model implies, furthermore, that more is necessary than a general active, attentional state in order for reading to take place. The required active attention implied by the model is "goal-oriented", not general, in nature. Attention must be directed to something, not just activated. When one asks a student to "concentrate" or "pay attention", one is telling him no less than to be ready for anything which might occur. If the student actually tries to follow this advice while attempting to read, the results will be disastrous. To the extent that he concentrates, in this "raw" sense of concentrate, he will become increasingly distracted and unable to "read". The result will be the familiar inability to remember what was said at the beginning of a sentence or paragraph when the end is reached. In terms of the model of reading as information processing, this phenomenon would be pictured as an overload of information or uncertainty, resulting in extreme cases, in an inability to process any information at all. The remedy in this situation would be to narrow the student's attention, i.e., decrease the uncertainty. This may involve emphasizing the student's preconceptions, fantasies, and internally determined mental activity, not de-emphasizing them. Such de-emphasis is equivalent to making him a kind of homogeneously cluttered slate on which all sensory activity has an equal probability of being written.

In summary, reading may be seen as a process of information processing in which information is conceived as internally existing uncertainty in the form of alternatives to be matched with sensory events. This model emphasizes the need for a limited, hence directed, amount of attentional activity in the reader as a necessary condition for reading. It conceptualizes the processing of information in the reading task as the reduction of uncertainty within the reader, not the gathering of "information" from the page.

REFERENCE

1. Shannon, C. E., and Weaver, W. Mathematical Theory of Communication. Urbana, Illinois: University of Illinois Press, 1949.

READING COMPREHENSION AS INFORMATION PROCESSING

Philip M. Clark
Ohio State University

Is reading comprehension a single skill or a composite of many skills? Attempts at definition typically lend themselves to positioning along a "specificity-generality" continuum, according to Rankin (13). Armchair analysis suggests that comprehension involves a large number of separate, specific skills (1, 7, 16, 17), while results of factor analyses suggest that reading comprehension involves a relatively few, general factors (2, 4, 5, 6, 11). Those who argue the "specific skills" position cite the "low" correlations between "general" reading ability and ability in "specific" subject matter areas, such as those reported by Pressey and Pressey (12) and Grimm (8). The "general factors" position should predict high correlations between general reading and specific subject area reading and between selections from different subject areas.

This paper will present a model which accomodates both the "specific skills" and the "general factors" points of view. Individual differences in information processing is the key variable for effecting the rapprochement. In brief, "divergent" thinking is appropriate for certain passages and "convergent" thinking fits others.

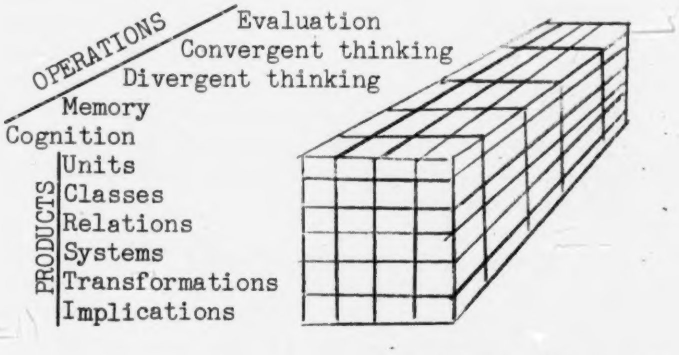
Models of Comprehension

Kingston (10) has reminded us that the reading process involves the total organism. He presented this point of view as a communications model.

If the organism has the requisite "reading skills" and if anxiety, lack of motivation or other "psychological factors" do not interfere, the reader will comprehend. However, input (the reading passage) must be pitched at a level of abstraction, experience level, developmental level, and linguistic symbol level commensurate with those of the reader.

This model does not, nor does it purport to, tell us anything we have not known. It does, however, represent an attempt to organize what we know in terms of the familiar input-system-output paradigm. In this case the output is defined in terms of the nature of the input and the "psychological condition" of the organism.

A somewhat different emphasis is provided by Guilford's (9) Structure of Intellect model:


OPERATIONS
Evaluation
Convergent thinking
Divergent thinking
Memory
Cognition
PRODUCTS
Units
Classes
Relations
Systems
Transformations
Implications
Figural
Symbolic
Semantic
Behavioral
CONTENTS

(Guilford, (9) p. 4)

Here again we have an input-system-output model, but this time there is no apparent attempt to define the "psychological condition" of the organism. The input is organized as various forms of content on the "Contents" face of the model (Figural, Symbolic, etc.), and the output is described in terms of various levels of complexity on the "Products" face (Units, Classes, etc.). The "Operations" face of Guilford's model is an attempt to describe the functions performed by the organism (or system) upon the input in order to produce the output. For example, a Symbol (Content) is Cognized (Operation) as Unit or a member of a Class (Product). It will be observed that the factors comprising the Operations face are aligned in a roughly temporal order for cognition through memory, convergent thinking and divergent thinking, to evaluation. That is, the performance of a function toward the right side of this face of the model implies the prior successful performance of at least some of the functions to its left. Cognition and memory, for example, would presumably be necessary prior to performance of any of the other three functions.

Individual Differences

This temporal organization of factors along the "Operations" face serves as an interesting and provocative description of human thinking and might also be construed to apply to the information processing which occurs during reading. However, it does not provide for individual differences in "style" of thinking or mode of processing information. Guilford's neglect of individual differences on the Operations face is understandable. It reflects a bias characteristic of the psychology of learning and thinking through the years. The tendency has been to examine the learning process or the reading process. As Spence (15) has pointed out, the testing of learning hypotheses in terms of the mean group result and the ignoring of individual curves frequently leads to distorted interpretations. Largely for this reason, it has been proposed that the "Operations" face of Guilford's Structure of Intellect be redesigned in order to reflect individual differences in modes of processing information. A consideration of the redesigned face will be helpful in our consideration of reading comprehension as information processing.

The establishment of an individual differences processing continuum running from high perseveration of input at one extreme to low perseveration at the other was recently undertaken (3). A broadly representative battery of twelve perceptual and conceptual tests, many of which were the same ones used by Guilford, was administered to a group of approximately 150 eighth grade students. The method of analysis involved inter-correlation of results, principal axes factor analysis solution, oblique rotation, and principal axes solution at the second order level. Results of the oblique rotation, the inter-correlation matrix of first order factors, and the results of the second order analysis are reported in Tables1, 2, and 3.

It was concluded that, given the battery of tests used and the sample of subjects tested, (a) it is possible to isolate at least three processing factors; (b) two of these factors represent basic modes or "styles" of dealing with input and the perceptual and/or cognitive level; (c) the factors at the extremes of the dimension define a continuum of information processing modes from high perseveration of input, thus, well defined visual patterns controlling responses, to low perseveration, thus, poorly defined patterns controlling responses; (d) the factor in the middle of the continuum emerged because the tests which load on it allow success by both those who are predominantly perseverative in their processing behavior and those who are predominantly non-perseverative, each using his own style. Those who score best on tasks defining the high and low perseveration ends of the continuum are called Convergent and Divergent types respectively, after Guilford. (Tests defining the high perseveration extreme are Concealed Figures similar to Gottschaldt figures and Memory for Designs; at the other extreme are Word Fluency and Gestalt Completion.)[1]

Comprehension as Pattern Discrimination

Let us now assume that reading equals pattern discrimination. That is, reading comprehension may be viewed as a series of responses to discriminative stimuli, consisting of letters and/or words and/or phrases, and so on. The introduction of the individual differences dimension suggested by the study cited above will now clarify the apparent discrepancy between the "specific skills" and "general factors" points of view.

The eye-movement study reported by Smith and Semmelroth (1963) strongly suggests that, during pattern discrimination, some unspecified number of discriminanda are required for recognition. If we can accept the reading process as a member of the class, pattern discrimination, and if individuals differ in discriminative style,[2] it would then follow that readers will differ in the amount of external input (Number of discriminanda) required to discriminate among symbols depending upon their modes of processing information. The Divergent type, that is, could be expected to require less stimulus support for recognition of a symbol due to superior "closure," the tendency to respond to poorly defined patterns. The Convergent type, on the other hand, should require more external support for recognition. Hence we should expect the Divergent type to be a rapid reader with relatively poor mastery of detail but good understanding of the overall message, and the Convergent type to be a relatively slow reader with good mastery of detail and perhaps great difficulty understanding the message as a whole. The former might be described as a "context reader" since he relies on only parts of the message, that is, a minimum of stimulus support. The latter has classically been called a "word reader" since he does not "close" well but relies on a relatively larger amount of stimulus support for discrimination.

---

[1] see also Rankin, E. F., this volume (Ed.)

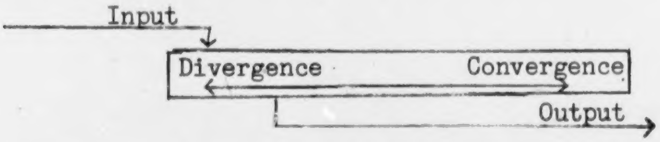
[2] defined as individual differences in perseveration of input.

The "specific skills" - "general factors" debate should be somewhat clarified by the proposed individual differences continuum. Apparent difference between word recognition and paragraph comprehension skills, for example, may be explained in terms of individual differences in processing modes. The so-called low correlations between general reading ability and reading in specific subject areas may well simply reflect differences in handling of various types of reading material depending upon whether the two reading tasks equally favor those with a Divergent or a Convergent style. For example, an argumentative passage presenting a logical and consistent line of reasoning should be more easily mastered by the Divergent type, whereas a historical article describing a battle, in which comprehension relies on mastery of names of commanding officers, details of positions held by various units, and intricate synchronization of movements might be more easily mastered by the Convergent type. A "low" correlation should be found in this instance.

The mode of testing would be expected to have an important influence on correlations also. Testing for detail should favor the Convergent type, while testing for main idea and inference should favor the Divergent type.

Furthermore, degree of familiarity with the subject area should influence the efficiency of comprehension and thereby the size of the correlation coefficient. That is, regardless of how a person processes information (divergently or convergently), he will comprehend material from subject areas he has had more experience with more efficiently than that from areas with which he had had less experience.

In summary, an input-system-output paradigm such as that used in information theory appears promising as a device for analysis of reading comprehension. This paper has focused upon the system portion of the model suggesting that it be expressed as an individual differences dimension rather than as a series of processing functions common to all people. The proposed model might appear as follows:



It is felt that the consideration of individual differences reflected here helps to resolve some of the apparent conflict among points of view regarding comprehension.

TABLE I
Biquartimin Rotation of
Three-Factor Orthogonal Structure
Primary Pattern

Test	Factor		
	I	II	III
Coding	.37	.04	.39
Word Fluency	.11	.08	.62
Brick Uses	-.08	-.04	.55
Gestalt Completion	.05	.11	.57
Mutilated Words	.16	.29	.35
Remote Associates Test	.41	.37	.08
Identical Forms	.17	.41	-.03
Memory for Designs	-.02	.62	-.00
Concealed Figures	.09	.68	.06
Picture-Number Recall	.67	.06	.00
Paired Associates	.57	.17	.06
Digit Span	-.00	.42	.11

TABLE 2

Three-Variable Intercorrelation Matrix of
Obliquely Rotated Factors

	I	II	III
Factor I			
Factor II	.39		
Factor III	.24	.30	

TABLE 3

Principal Axes Solution at Second Order Level

	I
Factor I	.53
Factor II	.56
Factor III	.44

REFERENCES

1. Bond, G. L. and Wagner, E. B. Teaching the Child to Read. New York: Macmillan, 1950.

2. Burt, C. "The Structure of the Mind." British Journal of Educational Psychology, 1949, 19, 176-179.

3. Clark, P. M. A Model for Individual Differences in Modes of Processing Information. Unpub. doctoral dissertation. University of Michigan, 1963.

4. Davis, F. B. "Fundamental Factors of Comprehension in Reading." Psychometrika, 1944, 9, 185-197.

5. Feder, D. D. "Comprehension Maturity Tests: A New Technique in Mental Measurement." Journal of Educational Psychology, 1938, 29, 597-606.

6. Gans, R. "A Study of Critical Reading Comprehension in the Elementary Grades." Teachers College, Columbia University Contributions to Education, No. 811. New York: Bureau of Publications, Teachers College, Columbia University, 1940, 1-135.

7. Gray, W. S. "The Nature and Types of Reading." Thirty-Sixth Yearbook of the National Society for the Study of Education, Part I. Bloomington, Ill.: Public School Publishing Co., 1937, 23-38.

8. Grimm, P. "Interpretation of Data and Reading Ability in the Social Studies." Educational Research Bulletin, 1940, 19, 372-374.

9. Guilford, J. P., and Merrifield, P. R. "The Structure of Intellect Model: Its Uses and Implications." Reports from the Psychological Laboratory, No. 24. Los Angeles: University of Southern California, 1960.

10. Kingston, A. J. "A Conceptual Model of Reading Comprehension." Tenth Yearbook of the National Reading Conference. Charlottesville, Va.: National Reading Conference, 1961, 100-107.

11. Langsam, R. S. "A Factorial Analysis of Reading Ability." Journal of Experimental Education, 1941, 10, 57-63.

12. Pressey, L. W., and Pressey, S. L. "A Critical Study of the Concept of Silent Reading." Journal of Educational Psychology, 1921, 12, 25-31.

13. Rankin, E. F., Jr. "The Definition of Reading Comprehension." First Yearbook of the North Central Reading Association, 1962.

14. Smith, D. E. P., and Semmelroth, C. C. "Micro-Movements During Apparent Fixations in Reading." Unpublished manuscript, 1963.

15. Spence, K. W. Behavior Theory and Conditioning. New Haven: Yale University Press, 1956.

16. Strang, R., McCullough, C. M., and Traxler, A. E. Problems in the Improvement of Reading. New York: McGraw-Hill, 1955.

17. Thorndike, E. L. "Reading as Reasoning: A Study of Mistakes in Paragraph Reading." Journal of Educational Psychology, 1917, 8, 323-332.

REVIEW OF RESEARCH: SKILL THERAPY

Daniel G. Sayles
University of Michigan

Emotional maladjustment and reading skill deficiency are thought to be related, judging from the large number of reports published in this area in the last thirty-five years. Most studies have addressed the question, "Is emotional disturbance a cause or a result of reading disability?" The position taken depends largely on the bias of the researcher and on the nature of the populations studied. There appears to be little doubt, however, that many cases of mild to severe maladjustment can be traced to failure in reading or in some other skill area (11, 12, 14, 15).

If skill deficiency frequently leads to emotional problems, it is certainly logical to conclude that effective remedial training will result not only in an increase in skill, but also in a positive change in affect. Most clinicians in skill areas are convinced that their successful experiences with clients clearly support such a conclusion. Nevertheless, among the hundreds of publications dealing with the relationship between affective variables and deficiency in reading or some other skill, it is difficult to find more than a handful which are concerned with observing or measuring the effects of remedial therapy on personality adjustment.

The earliest publications of this type are based on clinical observation, and are reported in the form of a series of case studies. Blanchard (3) described four cases, purportedly representative of a larger clinic sample, in which failure in reading resulted in such mild behavior deviations as daydreaming, over-sensitiveness, absent-mindedness, inattention, and "laziness." She stated that correction of the disability, and subsequent substitution of success for failure in school, was followed by a cessation of the behavior deviations. In a similar study of nine children by Monroe (9) it was asserted that successful remedial training in reading resulted in a simultaneous increase in confidence, perseverance, attentiveness and cooperation, as well as in a reduction of tension. Kirk's (7) study of the effects of remedial reading instruction in a group of maladjusted, mentally retarded youngsters indicated that the treatment produced not only a significant improvement in reading skill, but also a marked reduction in daydreaming, incorrigibility, inattentiveness, and negativism.

More recently, two investigators reported efforts to measure personality changes in late-elementary school boys who required remedial instruction in reading. Seay (13) administered the California Test of Personality and the reading sub-test of the California Achievement Tests to a group of seventy-two boys with average IQ's but deficient reading skills. The tests were also administered to a group of matched controls who were normal readers. The experimental group received individual remedial instruction several times each week for seventeen weeks. The tests were then re-administered to both groups. The experimental group showed a greater positive change in social self-concept and in total self-concept. There was also a positive change in personal self-concept, but this was not significantly greater than that found in the controls. Dunham (4) developed a scale to measure attitude toward reading, and administered it to twenty nine-year-old retarded readers who subsequently received twenty-two hours of small-group remedial instruction over a six-month period. The scale was also used to measure the attitudes of an equivalent control group who were on the waiting list for remedial training at the same clinic. There was a significant difference in reading gain between the experimentals (6-10 months) and the controls (0-4 months). A slightly greater positive raw score change in attitude among the experimentals was not statistically significant.

At the college level the hypothesis that development of a higher level of reading and study skill in reading improvement classes would be accompanied by positive changes in self-concept and in related personality variables was tested by two investigators. Englander (5) developed an instrument to measure self-concept in academic areas. The scale was administered to forty-six college students before and after a one-semester credit course in developmental reading, and to thirty controls before and after participation in a one-semester elementary public speaking course. For the experimental group, differences between means on pre-course and post-course administration of the scale were positive and significant in areas of self-concept as a student, self-concept in reading ability, and attitudes toward reading. No significant changes were observed in the control group. These results appear to support the investigator's hypothesis. Examination of the data, however, reveals that, in the three areas in which the reading group showed significant changes, the controls had significantly higher scores both at the beginning and at the end of the semester. The two groups were clearly not equivalent in this respect. The experimental group consisted primarily of self-referrals anxious about their ability to succeed, and the results of the study would have been subject to less equivocal interpretation had the control group also consisted of anxious self-referrals to satisfy the requirements of a rigorous design.

Raygor's (10) investigation of a similar problem involved a somewhat more complex approach. The reading skills of eighty-eight college students were measured before and after a non-credit, seven-week reading improvement course with equivalent forms of the DRT Survey. Responses on Factors C (Emotional Stability), F (Surgency), O (Anxious Insecurity), and Q_4 (Nervous Tension) of the 16 Personality Factor Test were obtained to measure anxiety symptoms at the beginning and completion of the reading course. Each of the subjects was placed in one of four personality categories as measured by responses on the SA-S Senior Scale. At the end of the course it was found that substantial gains in reading skill had occurred for all four of the SA-S types. There was also a significant increase in Factor C (Emotional Stability) for SA-S Type I subjects (extroverted and stable), and for Types I and IV combined (extroverted). Positive changes in Factor F (Surgency) were observed for the total group at the 5% level of confidence, and for SA-S Types II and III (introverted) at the 1% level. No significant changes in Factors O or Q_4 were found. On the basis of these findings it was concluded that increases in reading skill are accompanied by personality changes in the direction of decreased anxiety and increased emotional stability and self-confidence, but that these changes are specific to personality-type sub-groups rather than to the total population studied. Again, however, our interpretation of reported results must be tempered by realization that they were obtained from subjects who were not compared with a matched control group which received no skill instruction. It would be instructive to know what, if any, changes in anxiety responses would occur in a similar group of college students who pursued their regular academic and social activities without benefit of a developmental reading course.

An interesting and imaginative study was carried out by Jack (6) three decades ago, and, although not dealing with reading skill, it is relevant to the concept of skill therapy under consideration. Jack developed a highly reliable observer-rating scale for estimating degree of ascendance and submission. In a series of carefully contrived play situations, trained observers rated the behavior of eighteen pre-school youngsters with average or above-average IQ. On the basis of these ratings, the youngsters were divided into three groups: ascendant, moderately ascendant, and non-ascendant. The mean difference between scale scores of the ascendant and non-ascendant groups was 50 (SE = 6.3). The five youngsters with the lowest ascendancy scores were then given experience and skill training in three different situations. Two of these situations involved learning to make the visual discriminations and motor responses required for accurate and rapid assembly of a block design and a jig-saw puzzle, while the third necessitated learning to tell a story as accompaniment to a series of pictures in a book. All these tasks were practiced to a criterion of five consecutive perfect performances. Each of the five subjects was then placed with one other untrained child four times in each of the three situations for which he had been trained. Ascendant behavior was rated by concealed observers in these situations as before. Finally, all subjects were again rated in the series of initial play situations for which none had received specific training. It was found that ascendancy scores for four out of the five non-ascendant subjects showed a marked increase in the situations for which they had been trained. More important, however, is the finding that this increase in ascendancy transferred to other situations in which no training was provided, as indicated by the following ratings on the ascendance scale:

ASCENDANCE

Group	N	Initial	Final	Difference
Trained	5	38.4	77.8	39.4
Untrained	13	79.8	87.0	7.2

It can be seen that all subjects showed increases in ascendancy scores with age and experience during the months of the study, but the trained group made gains which were significantly greater than those of the controls. It is assumed that these gains were a result of the training received during the second phase of the investigation.

The studies discussed above tend to confirm, in varying degrees, the validity of the concept of skill therapy. There are, of course, questions concerning the extent to which skill therapy can be expected to be effective in alleviating certain kinds of degrees of maladjustment, particularly maladjustment resulting from factors other than skill deficiency. These reservations are reflected in the literature. Lipton and Feiner (8), for example, found that a group of severely disturbed fourth grade boys simply could not respond to remedial instruction in reading until after a period of group psychotherapy had reduced the anxiety evidenced in aggressive or withdrawing behavior. The well-known studies of Axline (1), Bills (2), and others also suggest that direct remedial instruction is far less effective than various kinds of psychotherapy with some problem readers. The skill therapist would argue here that, since control of attention is the first step in therapy, an adequate stimulus array would obviate the psychotherapy. Nevertheless, many studies raise doubts concerning the universal applicability of the concept of skill therapy, and even those investigations which tend to support this concept provide little more than a strong suggestion that it is valid in some cases. It is interesting to note, for example, that in Raygor's study the only subjects who showed significant increases in emotional stability were those SA-S types who were already stable and outgoing. We are justified in wondering, therefore, whether skill therapy is indeed an adequate approach with our most anxious clients. Is a more conventional form of psychotherapy required in these cases? Or is it necessary to develop more appropriate techniques for instructing the entrenched problem student in reading skills?

Additional research in this area is clearly warranted. Rigorously controlled experimental procedures can undoubtedly help to provide answers to some of our questions. Adequate methods for measuring change in affect also need to be employed And, of course, remedial techniques and materials which are the most effective we can develop must be used. Perhaps in this last category, at least, we are progressing to the point where we will be able to probe the question with new insight and skill, and to come forth with some surprising answers.

Daniel G. Sayles

REFERENCES

1. Axline, V. M., "Nondirective Therapy for Poor Readers," Journal of Consulting Psychology, 11, (1947), 61-69.

2. Bills, R. E., "Nondirective Play Therapy with Retarded Readers," Journal of Consulting Psychology, 14 (1950), 140-149.

3. Blanchard, P., "Reading Disabilities in Relation to Maladjustment," Mental Hygiene, 12, (1928), 772-88.

4. Dunham, J., "The Effects of Remedial Education on Young Children's Reading Ability and Attitude to Reading," British Journal of Educational Psychology, 30 (1960), 173-175.

5. Englander, M. E., "Changes in Affect Attributable to Instruction in Reading Improvement at the College Level," Journal of Educational Research, 53 (1960) 231-236.

6. Jack, L. M., "An Experimental Study of Ascendant Behavior in Preschool Children," Iowa Studies in Child Welfare, 9 (1934), #3, 9-65.

7. Kirk, S. A., "The Effects of Remedial Reading on the Educational Progress and Personality Adjustment of High-Grade Mentally Deficient Problem Children: Ten Case Studies," Journal of Juvenile Research, 10 (1934), 140-62.

8. Lipton, A., and Feiner, A. H., "Group Therapy and Remedial Reading," Journal of Educational Psychology, 47 (1956), 330-4.

9. Monroe, M., Children Who Cannot Read, Chicago: University of Chicago Press, 1932, 159-81.

10. Raygor, A. L., "College Reading Improvement and Personality Change," *Journal of Counseling Psychology*, *6* (1959), 211-217.

11. Sandin, A. A., "Social and Emotional Adjustment of Regularly Promoted and Non-promoted Pupils," *Columbia University Child Development Monographs*, *32*, 1944.

12. Sears, P. S., "Levels of Aspiration in Academically Successful and Unsuccessful Children," *Journal of Abnormal and Social Psychology*, *35* (1940), 498-536.

13. Seay, L. C., "A Study to Determine Some Relations Between Changes in Reading Skills and Self Concepts Accompanying a Remedial Program for Boys with Low Reading Ability and Reasonably Normal Intelligence," unpublished doctoral dissertation, North Texas State College, 1960 (reported in *Dissertation Abstracts*, *21*, 2598-9).

14. Wiksell, W., "The Relationship Between Reading Difficulties and Psychological Adjustment," *Journal of Educational Research*, *41* (1948), 557-8.

15. Zolkos, H. H. "What Research Says About Emotional Factors in Retardation in Reading." *Elementary School Journal*, *51*, (1951), 512-518.

SKILL THERAPY: A TREATMENT RATIONALE FOR EDUCATORS

Donald E. P. Smith
University of Michigan

Mental health thinking permeates educational practice. Most teachers, for example, have a nodding acquaintance with Freudian thought, and most include in their lexicon such terms as adjustment, rapport, tensions, defenses, and the like. Specialized educational workers reflect the bias even more clearly. Psychometrists frequently qualify their intelligence estimates with references to anxiety, obsessive behavior, disturbance, autism, withdrawal, etc. Furthermore, we are now training de facto mental health workers, among which visiting teachers, teachers of the disturbed, crisis teachers, and critical incident teachers are the most apparent examples.

An increased sensitivity to the affective state of the learner has enhanced our teaching effectiveness. Witness, for example, the number of useful techniques which have become available for manipulating the learning environment. On the other hand, we have also paid a price. "He doesn't learn and he is disturbed" slips easily into the casual construction, "He doesn't learn because he is disturbed." Thus the mental health movement has given us another diagnostic category with which to justify avoidance of teaching. In historical perspective genetic explanations ("His father was the same way") have given way to motivational ones ("He's too lazy"), succeeded by intellectual aphorisms ("He's too stupid") and, finally, to the personality epithet ("He's sick").

The strongest justification for such explanations is the comfort they afford the teacher. They are of little value to the learner. At best, they sometimes lead to an appropriate referral. But the referral procedure has its own problems. It is commonplace for a child to be referred from one child-care agency to another until he reaches school-leaving age; then other agencies must take over, rehabilitation workshops, county welfare, family aid, or the courts.

But the purpose of this paper is not simply to deplore the use of diagnostic labels. Rather, the purpose is to describe a way of thinking about learning and emotionality which may lead to educational techniques for improving both school achievement and mental health. Three brief reports of reading clinic clients will provide illustrations of the therapeutic process. An analysis of these in terms of skill therapy will then be evaluated.

CASE REPORTS

Consider the following referrals:

1. Alicia, aged 10, Stanford Binet IQ, 60, 69, 62; "special room" (retarded) placement for two years; she is "severely disturbed" according to her teacher, who also reports that she is highly distractible. She has made no apparent academic gains, and when given a reading test, she failed to report any words. Tests of auditory and visual memory, visual discrimination, closure and visual alternation revealed a primitive condition, perhaps a five year perceptual retardation. During an interview, she sat close to her 11 year old sister (also retarded) and remained immobile and unresponsive.

Her behavior suggested a fear-related withdrawal. The mother was asked whether the children were mistreated by the father. She reported a history of paternal violence.

Treatment: Alicia was given a letter discrimination task, programmed so that it becomes progressively more difficult, but in such small increments that the learner is usually unaware of the increase. She was hesitant, but having started she continued at a steady (successful) rate until stopped. She looked disappointed at having been stopped and was assured she could do more at another time.

Result: She arose, skipped to her mother and began discussing the office and adjoining room with vivacity and clarity of detail which was difficult to reconcile with her previous behavior or with her reported intelligence. Three psychometricians in attendance expressed disbelief at the changed behavior. (This was the first step in a treatment currently in progress.)

2. Jonas, aged 11, Stanford Binet IQ, 96, was referred as reading retarded (low comprehension). He had been encopretic (soiling) since age six, shortly after his parents' divorce. His mother, an alcoholic, had been declared an unfit mother. He had since been in the care of his father and paternal grandmother and later, of a stepmother. His encopresis had not been alleviated during two years of psychotherapy. He was a clinging, intrusive, "loving" (manipulating) boy. Perceptual test results were similar to those of children who alternate between extreme fear of persons, followed by anger, followed by fear of the consequences of their hostility, in turn followed by anger, etc.

Treatment: During tutoring, limits were stated and enforced consistently. Manipulative behaviors received a neutral response. Primary target was comprehension, so the cloze technique was used, with simple materials becoming progressively more complex. Gains were rapid; increased skill was accompanied by apparent increased confidence and brashness; encopresis was arrested with no recurrence. Jonas was returned to school reading at grade level after two semesters of tutoring.

3. Bob, aged 24, engineering student at the University; history of reading and spelling disability; two years in Navy at rank of Chief. Bob was self-referred after having been placed on the "home-list" for academic failure and appealing for another semester. He insisted that he knew his material, even tutored other students, but panicked on examinations. Furthermore, one instructor refused to pass him until he learned to spell. His reading skills were primitive, far below the norm limits. He reported that he had studied spelling several hours each day for six months while in the service. His attempts had been unsuccessful.

Treatment: The relationship between spelling disability and tension was explained; he was assured that he could succeed; he was then taught the Fernald "hand-kinesthetic" procedure and required to learn thirty words per week. As the weeks proceeded, a long-term retention increased. He was then given speed reading training on simple materials and difficulty was gradually increased.

By semester's end, he read at a first year college level. Spelling had stopped giving trouble. He reported only one experience of panic on an hour examination. His semester average was slightly above B and he was reinstated. He subsequently completed his degree.

DISCUSSION

These youngsters were chosen for discussion because of certain similarities. Each demonstrates emotionality: Alicia's distractibility and pseudo-catatonia; Jonas' clinging dependency and manipulatory behavior; Bob's exam panic.

Each also demonstrates symptoms in the cognitive realm: Alicia's apparent mental retardation; Jonas' low comprehension; Bob's spelling disability and academic failure.

Furthermore, each responded to training in perceptual skills. I do not mean to imply that they would not have responded also either to psychotherapy or to chemotherapy. It is quite possible that they would. Choice of treatment, however, was dictated by two considerations: First, the immediate adjustment problem was in the educational realm (school achievement); second, the major competency of the agency at which they appeared was in educational skills.[1]

Training in perceptual skills rather than in some other content was not entirely adventitious. It was based on the following rationale. Discrimination and Emotionality: All organisms, when placed in a novel environment, exhibit "emotional" behavior. That is, behaviors may be either diffuse, non-specific, even hyper-active, or they may be catatonic: The organism may remain immobile for a time before venturing out to explore the environment. Which kind of reaction occurs may be species-specific, or perhaps a function of the individual organism's history, or both.

---

[1] If this argument appears quixotic to those who know the writer's prior work, the reasoning is as follows: the human organism may be viewed as a system, physiological, psychological, pedagogical, etc. With adequate techniques, workers in each discipline can facilitate adjustment of the system to its surround. In so doing, they inevitably change the appearance of that system to workers in other disciplines. For example, the child treated with Dexamil appears less neurotic and achieves academically. The child in successful therapy has better eating and sleeping habits and achieves academically. The child who overcomes academic handicaps subsequently has better eating and sleeping habits and appears less neurotic. For, after all, the child as system is unaware of scientific discipline.

The exploratory period which follows appears to entail discrimination of the parts of the surrounding environment or stimulus array. Each part of the surround becomes an entity as a result of its consequences: "This place is safe"; "There is food here"; "Here is a place to sleep." In verbal organisms, we might hear: "There is a window"; "Those are desks"; "That is where the teacher sits"; "That's a big blackboard like my little one." The consequence, in the latter case, might be a reduction in tension, i.e., uncertainty, each time a part of the environment stands out and is recognized, i.e., named. The process described appears to fit Skinner's term, "habituation."

Within the educational environment, the first discrimination task is that of habituation to the room, the teacher, and other students. The second task is the discrimination; recognition or naming of letters, words, numbers, and other symbols. Aside from its effect on self-concept, failure in these discrimination tasks leaves the learner in his original state of emotionality. Each time he is faced with print, he becomes emotional, i.e., he has yet to learn the necessary tension-reducing response. In brief, he has not discriminated the parts of the array. He may, in fact, find that looking away from the page to familiar objects is tension-reducing, and thus learn to withdraw from print.

If such is the case, discrimination of letters, words, and, later, sentences and longer units, would appear to be the principal "content" of therapy for children with reading problems. A mental health point of view suggests, then, that emotionality be reduced so that discriminative learning can take place. The skill therapy point of view requires that discriminative learning take place so that emotionality can be reduced.

Analytic Theory:
Let's look at the thoughts of personologists on the need for and the contents of therapy. Most assume some positive force toward growth, a life-instinct (4, p. 132), or more commonly, self-actualization (2, 5, 7). A counter-force is provided by the environment (2, 5) usually interpreted in terms of social demands (1, 3, 8, 9). Anxiety is thought to result from an abrupt change in the balance between force and counter-force, in which the environmental force threatens to immolate the ego (5, 6, 7). The result, according to Lewin, is a "tendency toward encapsulation and an increase in the rigidity of tension - system boundaries". (6, p. 110)

Psychotherapy is required when a state of anxiety persists. Its persistence is thought to result from early learning occurring in the parent-child relationship, so that all later interpersonal relationships are affected. Presumably, then, the "contents" of therapy should be interpersonal transactions. But, according to Rank, the specific contents are of negligible importance:

> "This release from an overcome piece of one's own past, no matter in what content it is incorporated, represents the authentic therapeutic task and the meaning of every experience."
> (8, p. 72)

Donald E. P. Smith

Whether or not "released from the past" required resolution of early traumas appears to be the critical question. Such a resolution seems to be an impossible goal if viewed as a "working through" of the original problem as in analytic theory. Rather the aim should be to keep the learner's perception of the present from being contaminated by generalizations no longer relevant. To accomplish this aim, skill therapy emphasizes discrimination of the present as a new situation, different from the past, rather than improved discrimination of factors involved in previously experienced problems. Thus, any means for facilitating learning might be conceived as therapeutic. Relationship therapy, which facilitates social learning, is one such means. Skill therapy, which facilitates academic learning, may well be another.

Donald E. P. Smith

REFERENCES

1. Allen, F. Psychotherapy with Children. New York: W. W. Norton Co., 1942.

2. Angyal, A. Foundations for a Science of Personality. New York: The Commonwealth Fund, Div. of Publications, 1941.

3. Bronfenbrenner, U. "Toward an Integrated Theory of Personality", Chap. 8 in R. Blake and G. Ramsey. Perception, An Approach to Personality. New York: Ronald Press, 1951, 206-257.

4. Freud, S. New Introductory Lectures on Psychoanalysis. New York: W. W. Norton Co., 1933.

5. Goldstein, K. Human Nature in the Light of Psychopathology. Cambridge: Harvard Univ. Press, 1940.

6. Lewin, K. A Dynamic Theory of Personality. New York: McGraw-Hill, 1935.

7. May, R. The Meaning of Anxiety. New York: Ronald Press, 1950.

8. Rank, O. Will Therapy and Truth and Reality. New York: Knopf, 1947.

9. Rogers, C. Client Centered Therapy. New York: Houghton Mifflin Co., 1951.

10. Skinner, B. F. & Holland, J. Analysis of Behavior. New York: McGraw-Hill, 1962.

TECHNIQUE: THE INTENSIVE WORKSHOP

Olof Karlstrom
University of Michigan

The attempts to teach study skills in reading efficiency classes very often fails. Self-defeating habits persist and the desired skills are not developed. The same result often occurs when individual tutoring is undertaken. One reason for our failure may be inadequate feed-back to the student. If he is unaware of specific self-defeating behaviors, he will be unable to replace them. Therefore, we planned a study session which would allow skills counselors to observe the learner and to "reflect" his behavior.

An intensive one day session might bring about a change in behavior superior to that of spaced instruction, particularly if conditions approximating a classroom situation could be created. The plan was to present two capsule "courses" to the students. During the first "course," study behaviors would be observed and "reflected." Then, skills necessary for effective performance would be presented prior to the second "course." The "courses" would consist of useful information on the learning process. (See appendix for plan.)

The objective was to bring about necessary changes in behavior so that failing and near-failing students could achieve academic success. Ten staff members participated.

Olof Karlstrom

SUBJECTS:

Students involved were three males and seven females referred by academic counselors after term examinations. Eight were on academic probation. Seven had had a grade point average of less than 2.0 (based on a 4.0 scale) for the preceding semester. Included in the group were five freshmen, three sophomores, and two juniors. Participants were required to register at the Reading Clinic prior to the workshop and to pay a three dollar fee for expenses (materials and food). Participants were also informed that they must report to the clinic before 7 a.m. on a particular Saturday morning and that they would be released by 5 p.m.

PROCEDURE: (see appendix)

A rigid time schedule was followed; an alarm clock served as a reminder of limits. The day began with diagnostic testing of reading proficiency (Diagnostic Reading Test, Form A). Brief introductory remarks concerned the reasons for the participants' presence (academic failure), objectives of the workshop (academic success through effective study techniques), common motivational problems (concern about home or self, anger towards parents), and probable reasons for failure (lack of skill to make effecttive use of known ability). Students were also told that if they were confused at any time the fault was that of the staff. The solution was to let us know about the confusion so the problem could be clarified.

First Course:

Brief instruction was given in the techniques of surveying and skimming. Students proceeded with the "course" relying on whatever skills and procedures they employed in the learning process. The initial instruction was designed to give them a speed set in doing the assigned readings. After a pre-reading they heard a fifteen minute lecture and carried out a post-reading. Then they prepared for an exam. The staff was silent during this procedure. Each member observed two students and made notes on self-defeating habits and useful techniques. After the examination, the "charge" was made. Effective and ineffective habits common to several students were pointed out. What was good was stressed; what was detrimental was severely challenged. Students participated in this discussion and defended or explained why they employed the techniques they did.

Instruction:

Following a recuperative break, intensive instruction began. Individual staff members presented skill training within their particular competence. The rest of the staff interrupted, elucidated, raised questions of their own, and suggested alternative approaches. The result was an interaction of staff and students seeking answers. During the training exercises, staff circulated among students answering questions, observing progress, suggesting approaches, and insuring that instructional exercises were being carried out properly.

Second Course:

The design here was to follow instruction with application. Thus, the pre-reading assignment followed the presentation of study techniques employed in textbook reading. During the pre-reading, staff circulated among the students checking their progress and helping the students in their note-taking and organization. For the balance of the course the students were on their own to process and organize material in their own way. After the exam a post-mortem was held on examination problems. The examination was corrected immediately and returned to the students. Evaluation of their own progress was done by comparing scores on the Course 1 and Course 2 examinations.

Instruction:

Exam-taking techniques were now presented followed by instruction in time scheduling. Each student set up a time schedule for the following week. Recreation hours were included with a very strong admonition that they be adhered to. Finally, appointments were made with individual staff members for the following week. These sessions were held to go over problems encountered in applying techniques and to answer questions concerning particular subject matter areas.

Follow-up Session:

A two-hour meeting was held on the following Saturday. While the first meeting had been entirely directive, this was non-directive. The students responded well. There was excitement, anger, a number of insights, and an air of optimism. One young woman discovered and verbalized her subtle limits--testing, a kind of academic "brinkmanship" which accounted for her borderline standing. Another raged at the academic system, and followed it by four counseling sessions during which she discovered that her displaced anger originated from her symbiotic role. Others simply reported increased confidence. To what extent "halo" was operating we did not determine. Our concern was strictly confined to the academic success of these ten students.

RESULTS:

Mean grade point averages (GPA) are reported for both overall standing and for the semester during which the workshop took place. "Pre" indicates averages at the end of the fall semester. "Post" indicates average computed at the end of the spring semester. The workshop took place during the third week of the spring semester. Averages are reported on the basis of a 4.0 scale.

Period		GPA (mean)		
	N	Pre	Post	Gain
Semester	10	1.61	2.19	+.58
Overall	10	1.70	1.89	+.19

Period	GPA (range)		Total Class Hrs.	
	Low	High	Pre	Post
Semester	-.26	+2.01	155	154
Overall	-.13	+1.53	399	553

DISCUSSION:

Nine of the ten students involved raised their averages sufficiently to remain in school. The tenth, a freshman, came to us with a GPA of .93. At the end of the spring semester she had a GPA of .67 and an overall average of .80. She informed us that she had been commuting 60 miles by bus the week previous to the workshop since her father had been in an automobile accident. She arrived in Ann Arbor at 4 a.m. the morning of the workshop, walked 2 miles to the reading clinic, and waited for someone to appear. Despite this, achievement during the workshop was significant (she showed the highest gain in performance as measured by the difference between Course 1 and Course 2). She failed to keep four subsequent appointments with her counselor.

Of the remaining nine students, one did not return to school the following fall. Curiously, this sophomore male made the most significant gains. His change in semester GPA was +2.01 (1.07→3.08), and he was one of two persons who removed themselves from probation on the basis of overall record (1.69→2.00). Of interest is his comment made at the follow-up group session: "My life has been altered; it's difficult to explain." Perhaps there was more therapeutic value involved in this skill therapy then we have recognized. Along this line, another student presently seeing her counselor has suddenly recognized her anger towards her parents. Her present plans include dropping out of school, seeking a job, and becoming self-supporting. Her grades are adequate.

One other student showed no significant change. A sophomore, he suffered a loss in GPA of .12 for the two semesters. His overall GPA dropped .01 points and he remains in school. It is possible that the real effect of the workshop, if any, may not materialize for a time. One example of this is a freshman girl. She attended the workshop with a GPA of

1.47. At the end of the spring semester she had a GPA of 2.00 and an overall average of 1.74. She enrolled in summer school and compiled a GPA of 2.71, raising her overall average to 1.92.

Of the total of ten students, only one failed to raise or maintain his average sufficiently to remain in school. Six of the seven students with previous semester averages below 2.0 raised them to or above the 2.0 level. Two of the eight on academic probation removed themselves completely from that status, and two of the ten students failed to show any appreciable gain in GPA.

IMPLICATIONS:

This academic "shock treatment" cannot be evaluated with precision. It was designed to try out an idea; that an intensive learning experience, one designed to drive the student to exhaustion, would, if completely task-oriented with maximum feedback provisions, have an appreciable effect on the students. It seems to have done so. Perhaps other procedures would have a like effect.

Olof Karlstrom

APPENDIX

7:00 Diagnostic Testing
7:30 Orientation
7:45 Surveying and Skimming

8:15 1. Pre-Reading Assignment
"Frustration As a Factor In Behavior,"
Norman R. F. Maier,
Psychology in Industry, Chap. 4
"Anxiety," D. E. P. Smith (unpubl. paper)

8:25 2. Lecture
"Emotional Components of Reading, Learning, and Remembering"

8:40 3. Post-reading Assignment
"Habit," W. James, The Principles of Psychology, Chap. IV
"How to Concentrate," Ruth Strang, Study Type of Reading Exercises, College Level, Chap. 12
8:50 4. Review
8:55 5. Exam
9:05 The "Charge":
(Self defeating habits observed by staff)

9:30 BREAK

9:50 Learning From Textbooks
SQ4R (an adaptation of SQ4R as presented in
Smith, et. al. Learning to Learn)

10:50 1. Pre-reading Assignment
"Word Power As Concept Formation" (Smith,
et. al., Learning to Learn, Chap. 11)

11:00 LUNCH

11:30 To Learn From a Lecture
Smith, D. E. P., A Mathematical Program
(Experimental)

APPENDIX (continued)

12:30 Integration: SQ4R, Note-taking, and Exams

12:50 2. Lecture
"Organizing and Memorizing"
1:15 3. Post-reading Assignment
"The Development of Concepts" (a selection from Kingsley and Garry, *The Nature and Conditions of Learning*)
1:25 4. Review
1:35 5. Exam

1:45 BREAK
2:00 Taking Exams
2:20 Time Scheduling
Assignment to Counselors
3:00 Prepare Time Schedule
Individual Problems

4:00 DISMISS

TASK ANALYSIS - THE CRUX OF PROGRAMMING

Dale M. Brethower
University of Michigan

Task analysis is, I'm quite sure, the crux of programming. I'd like to begin a definition of task analysis by giving some examples of things that are similar to it.

Task analysis has much in common with writing an outline before writing a paper. It has much in common with writing the final examination for a course first, then outlining the course to teach the material required by the test. It has much in common with preparing lesson plans.

Task analysis differs from these activities: it is more systematic and more detailed. It differs in another very important respect: when carrying out a task analysis, one always and at every point asks, "Why am I teaching that?" If someone says, "I want to teach algebra," the task analyst asks, "Why?" "What is the end, the goal? Can you get there without algebra or can you get there more efficiently with less algebra or by some other means?" If someone says, "I want to teach students atomic weights and numbers," the task analyst asks, "Why?" "Why do students need them? Wouldn't it be more efficient, and, indeed, more accurate to look them up in a reference manual when they're needed?" We always ask, "Why?"

It's a little frightening how frequently the only reason we can dredge up to justify teaching a content is that someone taught it to us, or that everyone else is teaching it. A careful task analysis would probably show that most of the so-called "information explosion" is just a dust cloud being carried by the wind in the lecture hall.

Dale M. Brethower

One way of illustrating the importance of task analysis is to explore its relationship to task synthesis--to instructional programs which are the vehicles of synthesis in an instructional system. A few years ago, Dr. Bekesy received the Nobel Prize for his research in the area of hearing. He was asked why he thought he received the prize. He said, in effect, "You stay in your laboratory and you do your research and, after a while, they give you the prize." This is a simple technique but it doesn't work for everyone, so we question further. When asked what he does in the laboratory, his reply is somewhat more informative. "First you make the analysis, then you make the synthesis." When I heard Dr. Bekesy say that I must confess I didn't understand its import.

I understood the import somewhat better when Dr. G. A. Miller explained his interest in constructing a voice-operated typewriter. Dr. Miller's main interest at that time was in speech perception, not in engineering or manufacturing. He explained it this way: in order to build an electronic device which "understands" speech, you have to analyze speech carefully. And you have a very good check on the quality of your analysis if you try to use the results of the analysis to build a device which perceives speech. The test of the analysis is in the adequacy of the synthesis. Whether the synthesis is by means of a machine which types or a machine which talks is of lesser importance. The crucial thing is in the interplay between analysis and synthesis as a device for furthering research objectives.

The same interplay is crucial in furthering educational objectives as we are continually rediscovering in working with programmed instruction. One of the frightening things about programmed instruction is that, with a fair-to-middling program, students are quite likely to learn what's in it. It gives you pause. Maybe you'd better analyze further to make sure that what you are teaching is accurate and worthwhile. But be of good cheer. You can now check some of your assumptions about what is important. If your synthesis is adequate, you can determine whether your students are changed in ways that you want them to be changed. If they're not, you can re-analyze and, with a better analysis, come closer to your educational objective.

To summarize, task analysis is a set of techniques for doing the planning that you've all thought should be done in the development of courses. Coupled with the program, the vehicle of synthesis, it affords a check on the quality of an analysis and even on the value of one's educational goals. Task analysis, then, is a set of techniques for setting goals and for discovering what is necessary to achieve them. Furthermore the techniques of analysis and of programming are becoming refined enough so that one can learn them and apply them. Thus, one can receive enough reinforcement to continue doing very critical, exhaustive and exhausting analysis.

Now let me talk with you about a sample task analysis for a Reading Service such as the one at the University of Michigan.

Let's start by asking, "Why?" "Why have a reading service at all?" Perhaps it's to help produce successful students. That's a definable goal. "What's a successful student?" Let's say it's an undergraduate who, upon graduation, can enter the graduate school or job of his choice, providing that the choice is for one of the best schools or jobs. Let's also say that we want many of those who go on to graduate school to go there on one of the major fellowships available, such as the National Science Foundation, Woodrow Wilson, Rhodes or Danforth fellowships.

In doing a task analysis, one needs to find his own goals, whatever they may be, and to use them to guide his efforts. They serve, so to speak, as one's personal Occam's razor. Does some activity serve to get you closer to your goal? No? Then out it goes! Discovering that some of your pet notions are irrelevant to your goal is perhaps even more painful than finding that your favorite cold remedy doesn't really work.

Let's adopt as our criterion of success the goal of getting more people into good graduate schools (or jobs) and having more students get fellowships. Now, let's determine the criteria which admissions committees and fellowship committees use in making their decisions: grades; types of courses; scores on exams like the Graduate Record Exam, the Miller Analogies Test, etc.; information on the application form; letters of recommendation; the reputation of the school; and probably some others I haven't thought of. We'd have to do some investigating to find out exactly what criteria are used. Task analysis gets one out of the arm chair.

We now have our goal and we have the criteria. How do we fulfill the criteria? When we find out what patterns of courses are needed, we might cooperate with the counseling service (or set one up) to help get the students into the right courses and to let them know about fellowships, entrance requirements, etc.

Next are the letters of recommendation and the application forms. Let's find out what committees look for in these documents and prepare a brief self-instructional course which the applicant can use in filling out the application. Let's prepare another for people who write the letters. Maybe we could consult with counseling and guidance on this, i.e., lead them into doing much of the work.

The reputation of the school? We'll probably have to take it as it is. But let's make the most of what we have by making sure our students take courses from some of the highly respected individuals on the faculty. However, if we do our work well, the reputation will grow.

Grades and exams? Now we seem to be in an area in which a reading service is more at home. What are our goals? Let's agree that the goal is the production of students who study efficiently and who get high grades. You know why high grades are an important goal, but, as long as they get good grades, why is it important to us that students study efficiently? Part of the answer is that we are attempting to build our school's reputation and to get our students into the best graduate schools. We want them to be able to survive when they get there. Let me foreshadow the rest of the analysis a bit to give you another part of the answer. We want them to study efficiently so that they will have time to get good grades *and* to get an education. We all know that you can have one without the other. You can get a good education and poor grades. You can get good grades and a poor education. Our present goal is to see that students get good grades. We'll concentrate on that. However, we'll try to achieve it as efficiently as possible without subverting our student's goal of getting an education. In so doing, we may be able to give them more time to do it. We'll call the course we are going to develop by the descriptive title "coursemanship" or "How to Get Good Grades Efficiently".

What are the criteria for course grades? Performance on tests, projects, discussions and papers are some of them. Let's take a look at testmanship. What is the most efficient way of getting good grades on a test? Get the questions and answers in advance and learn the answers. Well, where do the instructors get the questions? They find them by thumbing through the textbook and their lecture notes trying to formulate questions. Why don't we teach our students to do that? If they're going to be asking questions, the questions should be good ones. What are the criteria for good questions? Three major criteria come to mind: 1) It must cover a crucial aspect of the subject matter; 2) it must require integration of large amounts of the subject matter, and 3) it must be one the instructor is likely to ask. After we've taught our students to ask questions satisfying one or more of these criteria, we need to teach them to find good answers to them. Armed with good answers to the questions, they should have little reason to fear an exam.

What are the criteria for good answers? Again three come to mind: 1) completeness; 2) accuracy; and 3) conformity to the bias of the textbook and/or the instructor. I grant that the application of one of the criteria for questions--the one the instructor is likely to ask--is going to result in the student's asking some questions which appear useless as judged by the criteria of importance and integration. And they'll have to do some violence to the subject matter in writing answers in conformity with instructor and text bias. But success smells sweet and our techniques of task analysis force us to take the world as we find it, not as we wish it were. Fortunately, in order to know what a good question is, a student must know what a bad one is. To separate fact from fiction and emphasis from inhibiting bias, the student must see examples of both. So, in teaching our student to apply the criteria, we are merely teaching him a useful skill. We are not leading him astray.

But _I_ am straying. The student needs to predict questions and to be able to write good answers. How can he tell when he has predicted enough and answered enough? That is, how can he tell when he is adequately prepared? Here we are as close to synthesis as the student usually gets. He will have arrived at several principles or general concepts in answering the questions. His criterion now is, do these principles relate to one another and do they organize all the facts? If not, is it because the principles are inadequate? If they do organize all the facts, can he synthesize, can he use them to generate new examples and to predict new facts? And can he classify all the examples using the principles he has developed? For example, if his sociology instructor makes a distinction between a group and an organization, can he produce an example of an organization which is not a group? Of a group which is not an organization? Of both a group and an organization? Of neither?

These are checks on completeness. If a student were to apply them thoroughly, he would probably be in a better position to assess accuracy than are most of his instructors. If he is working with inaccuracies, he'll never attain completeness.

The student's task, then, is to predict questions, to organize information, and to write answers. What are the sources of information available to the student undertaking this task? Lectures and class discussion comprise information coming in mostly through his ears; the printed page-- lecture notes, reading assignments, etc.--comprise information coming in mostly through the eyes. Now we are in more familiar territory--the printed page. But notice how long it has taken us to get there. Our task analysis has led us to seek answers to some more basic questions about why we want to get information from the page in the first place, what sort of information we want, and what to do with it once we've gotten it. Rather than our more usual tendency to start our analysis with the printed page, and to view reading as a task of absorbing everything on the page, we view reading as a task of asking questions, finding answers, and organizing information.

To summarize, in task analysis we determine where we want to go and why--always why. Then we start working backwards from that goal to find an efficient way of getting there. We do what we have to, even if it means getting out of our arm chair, even if it means we have to cooperate with new people and to tackle new problems. We keep setting up criteria whereby we and our students can measure progress. We keep looking for better criteria and better ways of fulfilling them.

Dale M. Brethower

Think for a moment of the impact an effective course in coursemanship would have on your university. First of all, some of the faculty would be upset if they heard about it--as they eventually would. They would feel that it was merely a course in beating the system. They'd be right. However, it contains some skills that would be extremely useful to the students in getting an education, skills that would have positive merit such as detecting biases, unsupported facts, and the like.

Coursemanship techniques are of value in beating a system. If tests can be beaten by testmanship, let's do the testmakers a favor and provide students who can do it. Then the testmakers can develop better tests. If courses can be beaten by coursemanship, let's provide students who can do it so the instructors can find the weaknesses in their courses and correct them. If instructors were to do adequate task analyses of their courses and to teach them well (or provide good instructional materials), much of a course in coursemanship would be obsolescent. The self-same techniques would be techniques of achieving the goals of an adequate system instead of being, as they are now, techniques of beating an inadequate system.

STRUCTURE OF A PROGRAM FOR COLLEGE COMPOSITION

Hal R. Weidner
University of Michigan

Writing an essay has much in common with designing a cross-word puzzle. Drawing such an analogy reveals the architectural nature of the writer's task. He must construct an inter-related framework from a limited repertory of words, concepts and experiences. Apart from the extent and nature of the materials, the measure of a puzzle's worth is not its size. Rather, it is the frequency and extent of its "overlap", i.e., the degree to which the puzzler avoids "blacked-out" spots by substituting integrated content. The writer's task, as puzzle-maker, consists of constructing a cloze exercise. The framework which determines the cloze response is mainly one of logical and rhetorical form, i.e., the "grid", within whose constraints the writer defines his thoughts.

The program for college composition teaches the basic forms of logic and rhetoric by providing varied examples of writing. Each sequence contains examples of a common sort. As a sequence progresses, each example is rendered less complete, requiring the student to create any parts necessary for its completion. Little by little, the example is removed while, piece by piece, the student restores it to completeness, until finally the student himself invents the entire example. To replace the missing parts of any given complex, the student first learns to recognize the genuine complex among imposters by comparing them with a model. The student learns to produce the parts of any complex by selecting from two alternatives (one correct, the other almost correct) the one part needed to complete an unfinished model. Subsequently, the student invents the required completions, then the entire complex.

Hal R. Weidner

The following pages will give part of the program structure, with a few examples taken out of the many kinds included in the complete program.

I. ORIENTATION TO WRITING

Technique: Discrimination and cloze exercises.

Given: Context and choices.

Behavior: Choose the word which yields the more precise message.

Example:

involvement
In my past in training
experience
dogs, I have discovered a certain
relationship between the dog and
companion.
its
trainer.

Terminal Behavior: Given imprecise or illogical sentences or paragraphs, student will rewrite correctly.

II. ORGANIZATION

Structure of a syllogism (a paragraph requiring three interrelated definitions).

Technique: Cloze exercises on the logical relevance of a word or term.

Given: A three-part deductive form and choices for completion.

Behavior: 1) Determine which of two terms represents the more general class; 2) determine correct sequence of terms; 3) discriminate relevant terms; 4) reverse sequence to write a three term essay. In the following example of (3), (discriminate relevant terms from irrelevant terms) "relevance" is defined as "validity".

Example: (3)

Circle the valid third term definition of Jack.

1) Some animals have fleas.
2) Jack is an animal.
3) Therefore, Jack is-
   A. -one who sometimes has fleas.
   B. -one who could have fleas.

Example: (4)

Reverse the order of the three terms above in writing them below.

Jack is one who could have fleas,
2) because______________________
1) and __________________________

III. DEFINITION

The paragraph viewed as an analogy requiring definitions. The definitions will reveal the similar and dissimilar characteristics of two things.

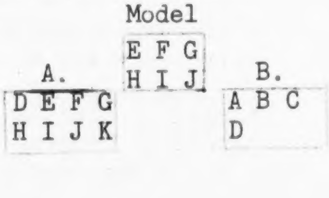
Technique: Discrimination task in selecting similar parts from various complexes.

Given: Things and characteristics of things.

Behavior: Analyze by asking check-list of questions demanding a number of definitions; discover similar and dissimilar components of things.

Example: III_1

In its overall performance, which one (A or B) would probably function most like the model?



Example: III$_2$

To best describe a truck to someone from a backward country who has never seen one, which (A or B) would you choose?

A.	B.
A donkey-cart	A hay wagon

Terminal Behavior: Given the name of a thing, the student will provide names of things which possess similar characteristics.

IV. PROOFS

A. BY CONGRUITY

Demonstrating the congruity of a statement about a thing with the characteristics of the thing itself.

Technique: Discrimination task in determining structural and functional implications of statements about things; cloze exercise in relating function to structure.

Given: A list of random thoughts about things (characteristics in sentence form), and choices among statements about the same things.

Behavior: Justify a statement about a thing by listing the relevant characteristics of that thing.

Example: Ambitious, cruel dictators throughout history have attempted to suppress open disagreement with their policies.

Hal R. Weidner

My new teacher is:

1. cruel
2. ambitious
3. dictatorial

therefore:

A.	B.
He probably will-	He probably will not-

-attempt to suppress open disagreement with his policies.

Complete the Essay

My new teacher will probably attempt to ____________________ because he is __________, ______________ and ______________ and throughout history ______________________________ ________________.

Example: Which thing (A or B) would probably function like the model?

Model

Characteristics:

1. porcelain
2. color: blue
3. small handle
4. water-tight
5. cylinder, closed at one end

	A.		B.
1.	plastic	1.	porcelain
2.	color: red	2.	color: blue
3.	small handle	3.	small handle
4.	water-tight	4.	extremely porous
5.	cylinder, closed at one end	5.	cylinder, closed at one end

Complete the Essay

_______________ should probably function like the model because they share the essential characteristics of _______________, while _____________________, on the other hand, lacks the property of _________________.

Terminal Behavior: Given a statement about a thing, the student will produce those characteristics which would justify its membership in a class.

B. BY ANALOGY

Describing an unknown in terms of a known, with an evaluation of their points of difference.

Technique: Cloze exercise in selection of relevant characteristics.

Given: Statements implying similarity between things and lists of their characteristics.

Behavior: Determine which characteristics are relevant in establishing a given basis of similarity.

Example: While tool X is not a hammer, it has:

1. A steel head
2. A flat face
3. A wooden handle
4. A similar size

A	B.
so it would probably function as a hammer.	so it would probably not function as a hammer.

Complete the Essay

While tool X is not a hammer, it has, (1)____________ (2)________ _____ (3)____________ (4)________ ________ and the characteristics essential to a hammer's function are______________________________ ______________________________.

Example: Choose with (A or B) in the middle term.

1) All people having characteristics
   A B C
   D E F
   are good fellows.

2) Jack has-

A.	B.
A B C	A B C
G H I	D E F

3) therefore, Jack is a good fellow.
   Reverse the order and write a three term essay.

Terminal Behavior: Given a thing and a statement about it implying a cause and effect relationship, the student will:

1) analyze characteristics of the given thing;
2) find a second thing with similar characteristics;
3) specify the basis of similarity and inter-action relevant to the statement, then draw a conclusion about the probability of or the degree to which the statement is justified.

V. SUPPORTING THE ASSERTION

Demonstrating similarities between general statements and specific statements.

Technique: Cloze exercise in composing an argument from a list of statements.

Given: Assertions and list of relevant and irrelevant thoughts.

Behavior: Select those thoughts relevant to proving the assertion correct.

Example: Thoughts on Drug Addiction:

1. law enforcement lowers supply
2. hence drives selling price up
3. so makes running risks more profitable
4. and success of avoiding law increases
5. thus increasing expenditures by law
6. which in turn are rendered ineffective by counter-measures
7. drains police resources
8. to make illegal business unprofitable, another source needed
9. but physicians couldn't handle discreetly
10. addicts will want increasingly larger doses
11. and can supplement prescription from illegal market
12. most addicts wouldn't go to a doctor
13. addicts are afraid of discovery
14. administering drug program drains medical manpower
15. ease of availability will increase addiction
16. legal prescription would be condoning an immoral practice

Which assertion would all the thoughts support?

A.	B.
No single step will resolve the problem.	Addiction can be controlled by increased law enforcement and prescription practices.

Which thoughts support the following assertions?

____1. Increased law enforcement can remove illegal drug traffic.
____2. Doctors could control the addiction increase.
____3. Increased law enforcement cannot reduce traffic.
____4. Management of drug addiction will be costly.

Terminal Behavior: Given an assertion, the student will list thoughts supporting it.

VI. ORDERING

Working from uncertainty towards certainty, explaining the unfamiliar in terms of the familiar. Fulfilling the promises of an assertion.

Technique: Discrimination task in placing thoughts in correct relative sequence.

Given: A prescription for ordering; examples of prescribed order; partially completed examples and choices for insertion.

Behavior: Identify the prescription and the model essay; select correct inserts offered to complete essays; invent inserts for incomplete essays.

Hal R. Weidner

Example:[1] Rhetorical Form

The reader will ask the following questions:	Answer the reader's questions with:
a) What are you about to do?	a) Assertion
b) What do you mean?	b) Definition
c) How do you know?	c) Examples
d) So what?	d) Conclusions

Example:[2]

Steps of Definitional and Logical Form

1. (assertion) A statement which one intends to prove true.
2. (nominal definition) Classify all key words of assertion.
3. (descriptive definition) Describe characteristics of key words.
4. (examples) Illustrate general assertion by listing specific instances of it.
5. (conclusions) Restate assertion, this time in terms of the specific examples in step #4.

Number each sentence according to the step it illustrates.

An Essay

Every individual is prejudiced toward some thing in his environment. Prejudice is a mental leaning in favor of, or against, something. It is displayed when a person judges a class with an unwillingness to make exceptions within the class. A mental leaning can have widespread repercussions as in the integration issue, or almost none at all, as in the form of a mere bias towards dachshunds. The dachshund's proportions make him appear awkward. His short, stubby legs do not look long enough to support his body. His sausage shape invokes associations with "hot dogs" or "wieners", thereby winning the scorn of even the most well-meaning person, who willingly jokes about his appearance, while ignoring the many other qualities by which the dachshund might endear himself to man.

FINDING ANSWERS BY READING

Nancy B. Davis
Indiana University

From the administrative aspect of my job, I suffered an irritation every time I was faced with the inefficient use of our live staff. I have also observed students in a class patiently waiting for the instruction to catch up with what they needed, while other students weren't even started. In other words, the classic problem, individualized instruction, stimulated the current interest in programmed instruction at our Center.

The immediately useful step to take was to follow the lead of other centers by making available to students an index of materials offering various kinds of practice so that work could begin that was directly applicable to individual needs. However, when examining the materials closely from the viewpoint of independent study, we found that they simply were not adequate for many of our students, particularly in the area of techniques for finding answers. The complaint was that the discussion and suggested procedures made sense to someone who already possessed some degree of skill in finding answers but were not sufficiently specific to the student who needed to start from scratch, that is, the student who had no concept of how to locate and read only relevant material. There was too much talk about techniques for finding answers and not nearly enough talk specifying what to do in order to find them. Perhaps the fault lies in the practical commercial limits one book can have. In contrast, the range and control provided by a program can permit a student to learn and practice in a non-risk situation and then transfer the technique to reading where the grades count.

A brief quotation belongs here to illustrate the basis on which we can teach how to find answers by reading. Although this passage is directed to personality maladjustment, the terms used--befuddlement, conflict, inefficiency, and unhappiness--describe these students who need specific instruction, not just general talk. The quotation is from Wendell Johnson (1964) and reads:

> "What the maladjusted person cannot do--and what he must learn to do--is to specify the sort of answers he needs. This is a way of saying that he has a conspicuous lack of ability to ask questions in such a way as to obtain answers that would be relaxing, or satisfying, or adjustive. As soon as he develops such ability, he can take care of himself for all practical purposes.
>
> There cannot be a precise answer to a vague question. The terminology of the question determines the terminology of the answer. Scarcely any other principle is more important in relation to a consideration of the befuddlement and conflict that make for personal inefficiency and unhappiness."

But where to begin? The starting point to finding an answer is to have a question which is in answerable form. Therefore, assume that an answerable question is available, what then is the process for quickly and accurately finding an answer? Rather than trying to identify what the unsuccessful students could or could not do, we turned attention to trying to establish the successful model so that imitative learning could occur.

"What is in this article?" is a kind of question requiring attention to the clues which permit a statement as to the content covered. These clues are distributed throughout the material and can be identified by location, such as a table of contents, or by physical distinctness, such as topic headings or illustrations. Once located, the content of the clues can then be comprehended. A useful analogy is a radar screen. The question "What is there?" requires searching the entire range, then attending to whatever appears.

In contrast to the question requiring a search of the entire range is the question requiring an answer contained within relatively narrow limits of the content and indicates a different strategy. Attention is given to an entirely different set of clues, those that will locate the limits within which one can find the answer.

A useful question in this instance is "Where is it?" Attention is now directed toward clues which will identify what is going on but the reader does not yet comprehend content. Not until the correct location is reached does comprehension begin. The distinction between identification and comprehension must be made explicit for students who have not made such a distinction for themselves.

This breakdown into two distinct steps is necessary for training purposes. Data from exploratory studies failed to show a high correlation between skimming or selective reading and comprehension. In an extensive and intensive analysis of the nature of skimming, Grayum (1952) showed that a high score in total reading ability did not assure the ability to skim. A student may have a grasp of the technique but forever come up with incorrect answers through poor comprehension, contrasted with the student who comprehends at an adequate level but who holds no concept of an appropriate strategy.

This strategy takes the general form:

1. Select a key word from the question, that is, the sort of answer the question requires.
2. Select a second word which will serve as a reference point for the correct

location.

3. Identify what is going on in order to know when you are near the location if material is longer than a few paragraphs. In the case of short-length material, look for the key word and reference word.

4. When the location is found, read for comprehension of content.

5. Read just beyond to verify that all of the answer has been included, if more than a name or figure.

Going through the motions of the procedure is easy enough; the difficulty, of course, lies in attending to the correct clues, that is, the smallest clue with the biggest pay-off. The fullest use is made of a small amount of information.

Instruction is planned from simple to complex use of each step of the strategy with periodic review and combining the steps to perform the entire task.

Step 1 states, "Select a key word from the question, that is, the sort of answer the question requires." Training in specifying the sort of answer is a proper starting point. Questions which call for specific short answers and which contain interrogative pronouns, adjectives, or adverbs constitute a simple first stage. For example, "Who? Where? At what time? In what place? By what amount?"

Consider a question of this type: "In what part of the brain does CO_2 affect respiration?" The sort of answer required is the name of a part of the brain. Our successful model indicates that "what part" is the clue attended to, that is, the interrogative, and the attraction of the symbol CO_2 is ignored. Physical distinctness of print, such as a name, figure or italics, is useful when such items constitute the correct clue but they can be powerful distractors to the reader who does not have a strategy under control. Magicians certainly appreciate the power of attractive distractors, but the person who knows where to look comprehends the trick.

Training in recognizing the sort of answer required can progress to a question such as "What was the pattern of events leading up to the decision?" The successful model indicates using the smallest clue with the biggest pay-off. In this instance searching directly for the words "pattern of events" might pay off since it is rather standard practice for authors to summarize at the end of their meanderings. If the simple and direct clue is not present, not much time is lost by the reader who has perceptual speed, perceptual memory, and perceptual accuracy. This statement implies, obviously, that if a student lacks any of these perceptual skills, training is indicated. However, such training can accompany the program on techniques for finding answers.

Another kind of task students encounter is an assignment such as "Compare authors A and B." To find answers one must have questions in answerable form. "On what point are they to be compared?" "What did A have to say?" "Where?" and so on. If the correct interrogatives are chosen and then attended to, the form of the answer is known and can be searched for without reading irrelevant material.

Step 2 requires the selection of a word which will serve as a reference point for the correct location, and poses no particular difficulty if the first step is mastered. It is more a matter of acquiring a habit of a sequence of procedures.

Step 3 mastery--identifying what is going on in any particular part of an article--is relatively easy to acquire because students already have available the knowledge required. But once again, these students don't know that they know, at least not at a level of deliberate use. The materials

I searched tell students to note signal words. But telling is not enough. Students need to perform under the control of feedback whether by live teacher or machine in order to learn to use fully the information available in the words that are so common in our language that their worth is not appreciated.

An example is the presentation of a six-line passage composed of two sentences. The question asked is, "Is the main idea in this paragraph contained in the first sentence, in the second, or in both?" Even when cautioned that one does not have to know the main idea in order to answer the question, few students arrive quickly at the correct answer that both sentences are needed to convey the main idea. One merely has to notice that the second sentence begins with "yet"--one of those common but overlooked words. Exercises are needed that demand attention to this part of our language. Passages in which all words have been deleted that give any clue to the substance of the message are useful, for a surprising number of questions can be answered about the message from the remaining information. No one knows what the message is, but a source of information about the message has been recognized. A helpful discussion about this class of language is found in Skinner (1957), under Autoclitics.

Class sessions brought out another instance of attending to the best clue. An example of the form of question is "Is a marked discrepancy usually obvious?" We concluded that the pay-off clue is the word "marked" and that the word "discrepancy" can be ignored since the essence of being marked is to be distinguishable from another. Any number of items can be substituted for "discrepancy" and not change the base on which the question is answered. When a student's attention is directed to such clues, he can see the sense of it and with directed practice can become skillful.

Step 4 in the strategy--reading just beyond to verify that you have included the entire answer--was added to the model as a result of a small study using eye-movement photography. One thing we were seeking was visual evidence of the reading behavior we call "flexibility." As we expected, an examination of our photographs verified they were in accord with eye-movement research. As Taylor (1963) reported, "When readers stop searching and start to read, they read in a very characteristic manner."

Calculating average fixations per line or rate of covering material, then comparing results on oral, silent and skimming type reading sorts out people but does not show the actual performance. Photographs of the three tasks by a flexible reader and by the one-style reader demonstrate clearly the differences in procedure and will be used in the program to illustrate the strategy being taught. Enlargements of the photographs have been used with classes and I feel that they have added to the instruction as visuals often do.

Examination of the photographic records showed that those readers finding the answer rapidly and correctly read just beyond, which behavior was interpreted as verification. This step also showed up when successful strategies were discussed in class. The two safeguards to finding the correct answer apparently are step 2, selecting the reference word, and step 4, verifying that the complete answer has been obtained.

Those readers locating the key word rapidly but failing to find the correct answer were probably examples of premature closure as discussed by Rankin (1963).

Two other types can be classified: those who found the correct answer by reading the entire passage and those who read the entire passage then re-read probably because they missed the question in the first place.

Nancy B. Davis

The highest level training in this program as now planned is to give a statement to be evaluated along with the book containing the needed evidence. The statement must be turned into a question or questions in answerable form, attention given to clues for locating the several places containing evidence, then comprehending and composing answers. When we review the successful procedures for completing such an assignment, the distinction between technique and comprehension must again be recognized.

A final aspect to be considered in this programming of how to find answers relates to this distinction between technique and comprehension. In the same way that one general model of a systematic study procedure can be used by students differing in personality characteristics through emphasizing selected steps of the procedure, so do we believe that the general model for a strategy of finding answers by reading can be adapted to the differing needs of students. The set or appropriate emphasis can be made at the time of the diagnostic conference.

Nancy B. Davis

REFERENCES

1. Grayum, Helen Stolte. "An Analytic Description of Skimming: Its Purpose and Place as an Ability in Reading." Unpublished Ph.D. dissertation, Indiana University, 1952.

2. Johnson, Wendell. People in Quandaries. New York: Harper & Brothers, 1946.

3. Rankin, Jr., Earl F. "Closure and the Cloze Procedure." Presented at the sixth annual meeting, North Central Reading Association, held at the University of Michigan, October 25-26, 1963.

4. Skinner, B. F. "Teaching Machines." Science, 1958, 128, 969-977. Reprinted in Cumulative Record, Enlarged Edition. New York: Appleton-Century-Crofts, Inc., 1961.

5. Skinner, B. F. Verbal Behavior. New York: Appleton-Century-Crofts, Inc., 1957.

6. Taylor, Stanford E. "Visual Motility." Presented at the sixth annual meeting, North Central Reading Association, held at the University of Michigan, October 25-26, 1963.

SURVEY Q3R: SYSTEM OR SUPERSTITION?

David M. Wark
University of Minnesota

In the fall of 1963 a large-scale study skills training project was carried out in the residence halls of the University of Minnesota. The training program, and the beneficial effects it would presumably produce, was described in dorm-wide meetings early in the quarter. Students who asked for guidance from their trained residence hall counselors, and agreed to make daily reports, were taught the Survey Q3R study method (Survey, Question, Read, Recite, Review) (12). This set of specific techniques has been widely copied in various study skills manuals, either _in toto_ or with minor modifications (3), (5), (6), (9), (10), and (14). The almost universal endorsement of the system augured well for the success of the project.

The students' daily reports were collected and analysed to evaluate the total project. The attempt to teach study skills was surprisingly ineffective. Even considering possible weaknesses in the overall program, the results raised the heretical suspicion that the Survey Q3R system may not be entirely reliable. Perhaps its ubiquitous advocacy has been due to its face validity, rather than any demonstrable effectiveness. A review of the research on Survey Q3R was undertaken to evaluate its empirical foundations.

The research support for the published Survey Q3R method is at best inadequate. The method is most exhaustively described in _Effective Study_, (12). Each one of the four steps, (survey, question, recite, and review) is justified by specific cited research. These original sources were reviewed.

1. _Survey_.
The student is told to:

> "Glance over the headings in the chapter to see the few big points which will be developed. Also read the final summary paragraph if the chapter has one. The survey should not take more than a minute and will show the three to six core ideas around which the discussion will cluster. This orientation will help you organize the ideas as you read them later" (12, p. 29).

There is only one study offered in support of the Survey step (8). Two groups of 58 students each were equated on the Otis SA Test of Mental Ability, form A and Burgess Reading Scale. The experimental group was given 15 minutes training in skimming. Then each group read a 611 word passage on "Women and Marriage". The experimental group was given 25 seconds for a pre skim. However, this pre skim period was not counted as part of total reading time. The results are presented in Table 1.

	No Skim	Skim
Otis	57.8	57.9
Burgess	13.72	13.52
Reading time	2:54	2:12
Reading rate	210	277
Comprehension	77%	76.6%

Table 1

Rate and comprehension mean scores for matched groups of skimmers and non-skimmers. (Adapted from 8)

It seems that the pre skim group did read slightly faster than their well matched peers. The differences hold up even if the 25 second pre skim is added to the mean reading time (210 w/m vs. 233 w/m). However, the conditions of this research make a generalization to text book study highly premature. It was carried out under frankly experimental conditions (a psychology laboratory) and therefore probably contaminated by Hawthorne effect. A few minutes of timed reading on a short non-technical passage is hardly similar to reading the headings and summary of a text book. There is no evidence that the higher rates for the experimental group would generalize. In fact, Randall (11) reports that "Knowing a person's rate on a test, one can predict his rate of reading during apparently untimed study only 5 per cent better than just guessing" (12, p. 74). Moreover, there clearly is no evidence in this study that a pre survey had any effect on a student's ability to organize the ideas contained in a text book chapter. The comprehension test scores were almost identical for both groups.

2. Question.

For the second step, the student is instructed:

> "Now begin to work. Turn the first heading into a question. This will arouse your curiosity and so increase comprehension. It will bring to mind information already known, thus helping you to understand that section more quickly. And the question will make important points stand out while explanatory detail is recognized as such. Turning a heading into a question can be done on the instant of reading the heading, but it demands a conscious effort on the part of the reader to make this a query for which he must read to find the answer" (12, p. 29).

What are the data that support the step? The major support for the Question technique is a study done with six groups of college students, equated for reading ability on the Whipple High School and College Reading Test (4). The experimental group was given 20 questions (Q) before reading a 2000 word passage on either English literature or science. The control groups received no pre questions. Following reading, both groups took a 40 item test, containing the 20 Q items, plus 20 new (q) items. Two groups for each topic had immediate tests; one had a delayed test. Unfortunately the results are not reported in mean scores, but in ratios of Experimental to Control. A critical ratio, significant at .05, is given as 4.0 or greater. The results are presented in Table 2.

group	test	Q	q	Q+q
		LITERATURE		
1	immed.	E/C 6.8*	C/E 2.2	E/C 3.2
2	immed.	E/C 14.5*	C/E 4.5*	E/C 5.3*
3	delay 2 weeks	E/C 12.8*	E/C .05	E/C 9.0*
		SCIENCE		
4	immed.	E/C 10.0*	C/E 4.6*	E/C 2.1
5	immed.	E/C 8.5*	C/E 4.3*	E/C 1.5
6	delay 2 weeks	E/C 11.2*	E/C 1.1	E/C 10.3*

*p <.05

Table 2

Critical Ratios of Scores for Experimental (pre question) and Control (no pre questions) groups on pre question (Q) and new (q) items, and total test (Q+q). (Adapted from 4)

Clearly, on the Q items, pre questioning helped comprehension, since the Experimental group earned higher scores. But it also appears that having pre questions lowers a reader's comprehension on new (q) items, since the significant differences all favor the control group. Overall, the pre questions seem to be an aid.

But they also serve to interfere. If a student makes up the "wrong" question from a section heading, he may not learn a necessary response. In fact, no matter what question he develops, he will miss some information. A more searching study by Washburn (16) supports the same conclusion. Prequestions just before reading a section were an aid in answering pre-reading questions. But they were associated with a drop in ability to answer new items, especially about specific facts. There does not seem to be good evidence for the conclusion that "As might be expected, the group which had been given a list of questions before reading did better on these questions, but they also did as well as the other group on the new questions" (12, p. 18).

3. Read

After doing a survey and making up his question, the student is told:

> "Read to answer that question, i.e., to the end of the first section. This is not passive plodding along each line, but an active search for an answer." (12, p. 29)

There is no specific research cited to support the notion of active, non-plodding reading. Moreover, these are hardly clear, unambiguous instructions. It would seem well nigh impossible to differentiate "active" and "plodding" reading without referring to simple rate measures. But "active" reading, in the loose sense it is used above, clearly implies more than fast reading. The notion of "an active search for an answer" appears to be critical. Yet there are many different ways of looking for an answer. Skimming rapidly over a page is one. So is slow reading and re-reading. The instructors would seem to be metaphorical, and have only quasi inspirational effects, if any, on study skills.

4. Recite

> "Having read the first section, look away from the book and try briefly to recite the answer to your question. Use your own words and name an example. If you can do this you know what is in the book; if you can't, glance over the section again. An excellent way to do this reciting from memory is to jot down cue phrases in outline form on a sheet of paper. Make these notes very brief." (12, p. 29)

The emphasis of this step in the Survey Q3R procedure is on a specific form of note taking--cue phrases jotted in outline form from memory. The basic support for the "working notes" format is a study by Arnold (1). His well matched students read and summarized material in one of four ways: outlining, precise writing, underlining and re-reading. There were no significant comprehension differences using a variety of test item forms, on immediate and delayed testing. However, there was a slight, non-significant tendency for underlining and re-reading to be more effective. Arnold believed that since the students were not sufficiently trained in their assigned method, the results are inconclusive. In any case, the data do not support endorsement for outlining from memory. Two further studies (2, 13) demonstrate that students can indeed be trained to outline effectively. But there are no reported studies of the comparative effectiveness of students trained in all four methods. Until such a study is carried out, the question of the best type of recitation technique will be unanswered.

5. The final step in the procedure is ~~to~~ review the content of the working notes.

> "When the lesson has thus been read through, look over your notes to get a bird's-eye view of the points and of their relationship and check your memory as to the content by reciting on the

> major subpoints under each heading. This checking of memory can be done by covering up the notes and trying to recall the main points. Then expose each major point and try to recall the subpoints listed under it." (12, p. 29)

No attempt was made to review even the cited studies. The literature of recitation, memory, forgetting, spaced vs. massed review, interference effects, etc., is so vast that a survey of even the relevant studies would have been both time consuming and unnecessary for the purpose at hand--evaluation of Survey Q3R. The review to this point seemed conclusive enough. More searching would have been interesting, but hardly worthwhile.

CONCLUSION

The literature survey indicated some of the fundamental problems with Survey Q3R. The Survey step is based on an overly generous extrapolation from a short passage to a whole text. The Question step is advocated in the face of data which show that pre question may be a detriment to comprehension. The working note form of Recitation is probably effective, but no evidence is given that it is any better than simple re-reading.

A recent study by Wooster (17) investigated the whole Survey Q3R approach, taught in a 10 week "How to Study" course. Presumably the students in the course would have time to become well trained in the method, and would be able to demonstrate increased speed and comprehension or some similar measure of effectiveness. Most regretfully, the author used no control group. All comparisons are therefore pre and post measures on the same groups of students. The data of the Wooster study offer very little encouragement for the supporters of SQ3R. The students showed no increase in reading rate, and no increase in comprehension. Nor were the students uniformly enthusiastic about the method. At the 10th week of the course, only 65.5%

reported making a survey when they studied, and 55.3% reported making questions. (These data agree with 3 independent studies made by Wark (15). The only measurable change was in "work note" format, judged by the instructor to have become more effective. Clearly Survey Q3R was not highly successful in changing student achievement, or in maintaining student interest.

Where do we stand regarding Survey Q3R? It is a widely advocated method. Increasing numbers of recent high school graduates come to campus and say they have heard about it from their teachers. For the instructors who can enthusiastically espouse it and students who conscientiously apply it, Survey Q3R is probably not a waste of time. But there is no body of data to demonstrate that any other integrated package of skills would not work just as well. Like the legal age for marriage, Survey Q3R seems to be supported by tradition, rather than a rigorous consideration of the data on productivity.

REFERENCES

1. Arnold, H. F., "The Comparative Efficiency of Certain Study Techniques in Fields of History," *J. Educ. Psych.*, 1942, *33*, 449-457.

2. Barton, W. A., "Outlining as a Study Procedure," *Teach. Coll. Contr. Educ.*, 1930, No. 411.

3. Farquhar, W. W., Krumboltz, J. D., and Wrenn, C. G., *Learning to Study*. New York: Ronald Press, 1960.

4. Holmes, F., "Reading Guided by Questions Vs. Careful Reading and Rereading Without Questions," *School Rev.*, 1931, *39*, 361-371.

5. Hill, W., and Eller, W., *Power in Reading Skills*. California: Wadsworth Publishing Co., 1965.

6. Kalish, R., *Making the Most of College*. California: Wadsworth Publishing Co., 1962.

7. Levin, K., "Group Decision and Social Change" in Swanson, G. E., Newcomb, T. E., and Hartley, E. L., Eds., *Readings in Social Psychology*. New York: Henry Holt & Co., 1952, 459-473.

8. McClusky, H. Y., "An Experiment of the Influence of Preliminary Skimming on Reading," *J. Educ. Psych.*, 1934, *25*, 521-529.

9. Morgan, C. T., and Deese, J., *How to Study*. New York: McGraw-Hill Book Co., 1957.

10. Pauk, W. *How to Study in College*. Boston: Houghton Mifflin Co., 1962.

11. Randall, H., "A Study of Reading Efficiency Over Various Time Intervals and Under Different Work Conditions. Unpublished Master's thesis, Ohio State University, 1943.

12. Robinson, F. P. Effective Study. Revised Edition. New York: Harper & Brothers, 1961.

13. Salisbury, Rachel. "Some Effects of Training in Outlining," Eng. J. (Coll. ed.), 1935, 24, 111-116.

14. Smith, D. E. P., et. al, Learning to Learn. New York: Harcourt, Brace and World, 1961.

15. Wark, D. M., "Reading Rate Fluctuation During a 'How to Study' Course." Unpublished research, University of Minnesota.

16. Washburn, J. N. "The Use of Questions in Social Science Material," J. Educ. Psych., 1929, 20, 321-359.

17. Wooster, G. F., "Teaching the Survey Q3R Method of Study: An Investigatoral Approach." Unpublished Ph.D. thesis, Ohio State University, 1953.

THE "NEW LOOK" IN SKILLS TRAINING - A CRITIQUE

Richard Stevens
Notre Dame University

One comment that I feel pleased to make about the papers in this section is that together they present what may be called the "New Look" in the teaching of study. A week ago I wouldn't have believed that there could have been a new look. We have in the Developmental Reading Program at Notre Dame shelves of books on how to study, some of which date back 50 years and more. Reading them over had led me to believe that everything that could be said about study had been said. I suspect that the last important development in study technique was Robinson's work on SQ3R. In the generation since Robinson we have seen permutations and combinations of his formulations, but little that was really new. It appears to me that the current papers signal a new cycle. Initiated by the exciting new developments in programmed instruction, it is a cycle that will probably be extremely productive in a few years. I could not see in what was offered today anything that we could immediately apply when we go home. Nevertheless, I am convinced that we have a beginning that will certainly be productive.

One of the things most notable in this new look is the frequency with which the expression "models" comes up. As these papers were read I was surprised to see how psychologists and teachers are now studying far more precisely than formerly the desired response in specific parts of the study situation. Some speakers can be commended more than others, but all of them in my opinion improved upon the language, model, and teaching methods we inherited from Robinson.

It is worth noting that although the language is different, the older inherited study model can be made to fit in with some of the other formulations of study presented here. We have, for example, the work being done at Indiana by Dr. Davis. Her paper indicates the extent to which modern workers in the field of study are making much more precise the pre-reading activity of study. It presents detailed procedures that students should follow. Also notable in her paper are the suggestions about research procedure in validating new study techniques. To sum up my first general comment: we appear to be entering a stage in studying the matter of study which has already produced a refinement in the concept of what study is and further has produced new methods of teaching it. These methods are closely tied up with programmed instruction, and it is encouraging to see how rapidly these techniques are reaching sophistication.

My remaining remarks are somewhat more critical. I shall begin them by saying that in the field of study training there should exist a law which says that any study method taught students to get their work done ought to be simpler and more efficient in producing results than reading without the method. As a reading teacher, I too have study methods to teach students. I sometimes wonder whether my methods are harder to learn and apply than the reading was to begin with. I wonder if some of the approaches to study presented this afternoon are not subject to the charge of being unduly complex. We may find that we are making the steps in reading and study so numerous and complicated that a student would need a lengthy check list to guide him through the reading of a simple paragraph.

Another comment that I would like to make amounts to a cry for responsibility in "model making". Do I need to define what I mean by model? Let's call it a way of understanding reading which leads to methods of doing it. In my plea for responsibility in model making, I would like to ask that there should be some further attempt to validate them and the study methods they suggest.

Richard Stevens

It is worth pointing out that the "New look" study methods at present tend to leave little or no room for a personal response. Concerned only with a student's getting information, they ignore all questions and relations which are not matters of fact. What about questions of value, questions concerning how the reader feels about the material, about how he will use it, or whether he should argue with the ideas, or in some manner reorganize and restructure them according to a set of relations not contained in the text? I have long held the opinion that productive people and productive readers read well because they read personally, because they read to use and read to become. I believe good readers, even of textbooks, do not read just with a set of soaking up information.

To sum up my second comment, researchers and teachers of reading should exercise caution in their new models and methods of reading and study. They should take care lest they create a multiplicity of methods which are overly complex and detailed. They must further take care to assure all of us that the methods of study they recommend are valid in concept as well as productive in practice.

VISUAL MOTILITY

Stanford E. Taylor
Educational Developmental Laboratories

In many professional texts, reading improvement workbooks, and popular articles on reading, one finds expressed many misconceptions about the fundamental visual-functional and perceptual acts that initiate reading. In a survey of twenty of the more widely distributed reading improvement books and workbooks, eighteen contained statements about the visual-functional and perceptual acts that were in direct contradiction to the findings of research. The purpose of this paper is to explore the facts and fallacies relating to eye movements and reading and to answer certain basic questions related to visual functioning and the perceptual activity.

1. How much can the eye see? The chart below graphically represents the results of a study by Feinberg (5), who measured the fall off-of visual acuity for the emmotropic, or normal eye.

As a reader's eyes stop at any given point along a line of print, only four to five letters immediately around the fixation point are seen with 100% acuity. From this point of clearest vision outward to either direction, words and letters are seen with decreasing clarity. For example, portions of words that extend one-half inch outward from the fixation point are normally seen with less than 50% acuity. Words that occur one inch from the fixation point are seen with only 30% acuity. If the reader's vision is less than "normal", this fall-off is more pronounced. Of course, the reader will attempt to "use" some of the print seen with reduced acuity, but the small amount that he is able to use will be in direct proportion to the amount of visual discrimination (accuracy and orderliness) and visual memory

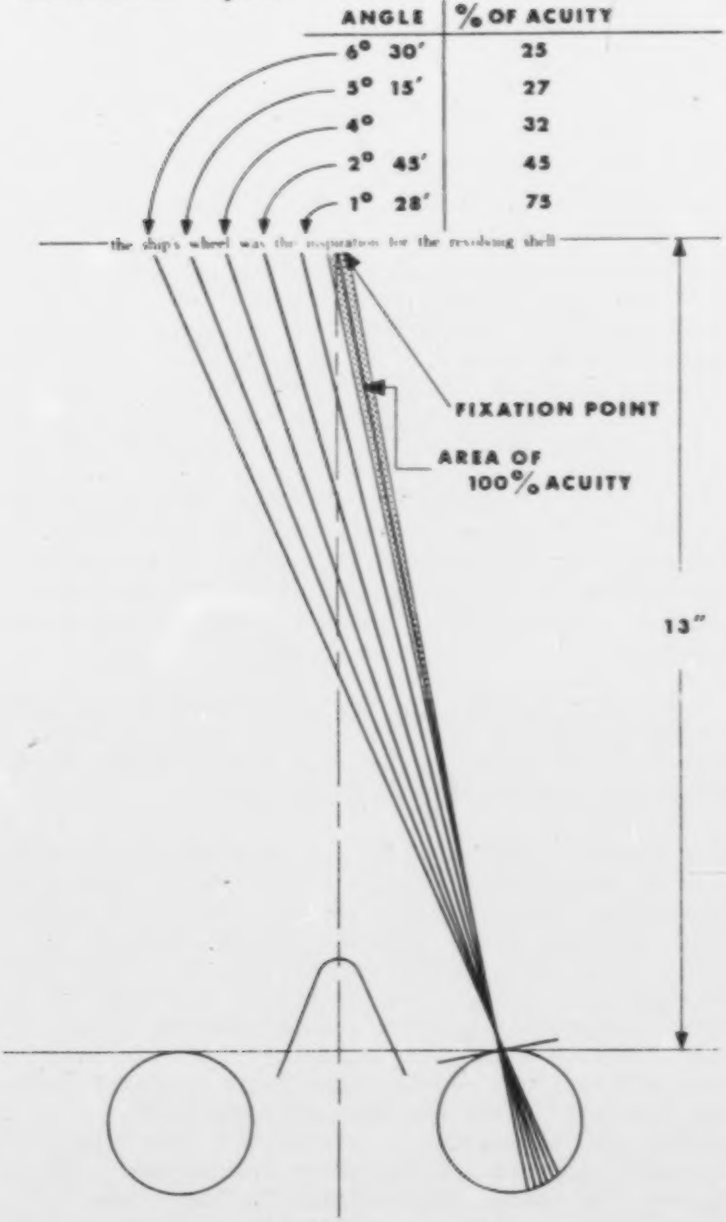

ANGLE
% OF ACUITY
6° 30'
25
5° 15'
27
4°
32
2° 45'
45
1° 28'
75
the ships wheel was the inspiration for the revolving shell
FIXATION POINT
AREA OF 100% ACUITY
13"

Figure 1. Visual acuity, percent of normal, as a function of visual angle.

(retention) that he possesses.

This typical fall-off of visual acuity explains in part why the average college reader has a usable span of recognition (average amount seen during an eye stop in reading) of only 1.1 words and why even superior readers, trained or untrained, seldom achieve a usable span of recognition of over 2.5 words. Norms (Table 1) based on eye-movement photographs of over 12,000 students (14), reflect the growth in usable span of recognition, which increases as the number of fixations per hundred words decrease.

2. Do we see only when our eyes are stopped, or is it possible to absorb print while our eyes are in motion? Research to date shows that vision is so reduced while the eyes are in motion that it is impossible for recognition to occur. In a study by Thomas (18), projected images were activated electronically so that they would appear only when the subject's eyes went into motion and disappear when the movement ceased. All of the subjects failed to see the material that was presented while their eyes were in motion. This study and others indicated that all persons identify and recognize visual material only during eye pauses, or fixations.

3. In reading, is it necessary to see all of the words? For complete accuracy, yes. When people question the need to see all of the words, they are suggesting that some words are more important as carriers of meaning than others. While this is undoubtedly true, it is not possible to read with a system of omitting words, for a reader cannot reliably decide which words are important until he first "sees" them. Any random omission can only yield incomplete comprehension.

4. What is the relationship between efficient oculo-motor performance and effectiveness in reading? Without exception, all eye-movement

Table 1

AVERAGES FOR MEASURABLE COMPONENTS OF THE FUNDAMENTAL READING SKILL (14)

Grade*	1	2	3	4	5	6	7	8	9	10	11	12	Col.
Fixations/100 w.	224	174	155	139	129	120	114	109	105	101	96	94	90
Regressions/100 w.	52	40	35	31	28	25	23	21	20	19	18	17	15
Av. Span of Recog.	.45	.57	.65	.72	.78	.83	.88	.92	.95	.99	104	1.06	1.11
Av. Dur. of Fix.	.33	.30	.28	.27	.27	.27	.27	.27	.27	.26	.26	.25	.24
Rate with Comp.	80	115	138	158	173	185	195	204	214	224	237	250	280

*First grade averages are those of pupils capable of reading silently material of 1.8 difficulty with at least 70% comprehension. Above grade 1, averages are those of students at mid-year, reading silently material of mid-year difficulty with at least 70% comprehension.

studies that have compared good readers with poor readers, whether on the basis of standardized test scores, grade level, or ability to read with flexibility, have shown that more effective readers make fewer fixations, fewer regressions, have a larger span of recognition, and display a shorter duration of fixation than do less effective readers.

The tables provided by Taylor (11, 12), Gilbert (6), and Buswell (3), in addition to the table of norms previously cited, provide eye-movement data on students at all grade levels which supports the fact that the better reader possesses more oculo-motor efficiency.

5. How does an individual acquire the oculo-motor activity that he employs in reading? The study by Taylor and Robinson (16) suggests that a child enters kindergarten with certain existing oculo-motor habits born out of his accumulated "looking" experiences. These are modified or built upon as he learns to read.

During the readiness stage of reading instruction, he is given a small amount of instruction in visual discrimination, and usually just verbal directions to help him form his directional attack. Throughout the beginning grades, his struggle with word recognition encourages an excessive number of fixations and regressions. Oral reading, though valuable in some respects, has the effect of encouraging an excessive amount of random ocular movements. Perhaps, too, he is handicapped with inadequate vision, poor binocular coordination and mobility. And so, through constant but unconscious experimentation, he evolves an oculo-motor activity that enables him to realize a reasonable degree of meaning from print.

6. Does the average reader alter his oculo-motor activity to suit the reading task? In professional books and articles on reading, there are many references to the importance of flexibility--the

need to vary rate and performance according to the nature of the content and the reader's purpose. While flexibility is undoubtedly a desirable goal, the fact remains that the average reader is quite inflexible in the way he copes with various reading situations. There have been many studies of the effects on reading performance of interest, type and difficulty of content, and purpose. From these studies, several conclusions have emerged:

a. Most people are not efficient readers and, as such, do not vary their reading approach to any great extent when reading for different purposes. Only the most efficient readers find that changes in approach come easily and naturally. Studies by Letson (7), Taylor, et. al. (13), McDonald (8), Sister Theophemia (17), among others, have shown this to be the case. The least efficient readers may actually find themselves incapable of altering their reading performance even when they set their minds to it. Others can force a change at will but do so with a significant loss of comprehension and an excessive expenditure of energy.

b. Variations in the difficulty of content within reasonable limits appear to produce little appreciable change in the performance of average (relatively inefficient) readers, as shown by the studies of Anderson (1), Morse (9), Ballantine (2), Letson (7), and Taylor, et.al. (13). Generally speaking, as long as a reader is not reading material too far above or below his level, he will maintain a fairly characteristic pattern. Material that contains difficult vocabulary and concepts can cause the reader to interrupt his reading to reread, stare or ponder. At the other extreme, when the content is so simple that it departs significantly from familiar linguistic patterns, variations will also occur.

c. Variations in subject matter have been found to produce less change than would have been suspected. Seibert (10) found some change in oculo-motor performance on the part of eighth grade subjects as they read geography, science, history, etc., but this change was so slight that it can be considered educationally insignificant.

d. The physical condition of the reader produces little effect on oculo-motor behavior. Carmichael (1) and Dearborn (4) found that prolonged reading produced mental fatigue but did not significantly alter oculo-motor characteristics.

In many of the studies cited above, it was found that only the better, or more mature, readers altered their performance significantly when approaching different types of content with different purposes in mind. The average reader, who is not very efficient, tends to maintain the same oculo-motor activity in approaching most types of reading unless extraordinary conditions interfere.

Many reading specialists, being aware of the relationship between the oculo-motor activity and reading effectiveness, seek ways and means of improving it. Unfortunately, many work towards changing the eye movements themselves rather than training the underlying skills that the eye movements reflect.

7. Can the oculo-motor activity be changed through the conscious control and self-discipline of the reader? It is interesting to note that almost all of the currently available reading improvement texts and workbooks tell the reader how to go about controlling and redirecting his eye movements, though they offer no evidence to support their assumption that this can be done. The following quotations are taken from some of the more widely used reading improvement workbooks:

> "Make your eyes divide the type lines into word groups--units of type--and you will quickly develop the faculty of seeing units

> of type pass swiftly before your eyes and become units of thought. Divide the type lines in the way word groups form naturally for you."
>
> "If regressions become noticeable in your reading, shorten the eye span or slow your pace until meaning and essential relationships are clear."
>
> "In fast reading of easy material, try to have no more than one regression every several paragraphs. In fast reading of solid material, try for no more than one regression per paragraph."
>
> "Run your eyes down each column, making one fixation per line."
>
> "Read forward. Let your eyes sweep across each line. Try not to look back and reread."
>
> "Under no circumstances should you allow your eyes to go back to pick up something they missed the first time."

It is appealing to think of the eyes as being smoothly and precisely directed by the mind in the process of reading. In reality, however, this is not the case. All available eye-movement research to date suggests that we do not and cannot control our eyes in each and every fixation; at best, we direct our eyes along the lines of print in a general way.

To understand why precise control over eye movements is not possible, it is necessary to realize that you make from three to five eye movements per second. In other words, in the time it takes to say "one thousand and one", you could have made five eye movements while reading. You are not aware of these movements because the shifts of the eyes are slight and produce little kinesthesia (sensation of movement). Because so many movements occur in so short a time, you experience only a general feeling of movement.

Most people who attempt to control their eye-movement patterns find that they defeat their own purposes. They must concentrate so hard on trying to "feel" what they are doing that they lose the thread of thought.

8. Is it possible to learn to read in large word groups or "phrases"? The theory, though fallacious, sounds logical: widen span, and thus decrease the number of fixations needed, and as a result, increase rate of reading. This theory is reflected in many reading improvement texts by such statements as these:

> "Skillful reading requires wide eye spans which encompass phrases and thought sequences rather than isolated words."

> "Good readers are not word-by-word readers. Rather they are phrase readers....They have developed a span of vision sufficiently large to enable them to take in a group of words at each fixation."

> "Read meaningful groups of words. Take in several words instantly, at a glance. Don't read word by word. This slows you down."

> "The truth is, your eye span is adjustable, and you can easily control the adjusting. 'See wider,' quickly capturing long words and phrases at a glance."

> "Practice looking down quickly at a line of print, lifting the eyes and checking to see how many words you saw in the fixation. Do this until you are actually aware that the span is increasing."

> "You should read ideas, not words. For instance, the phrase into the house should not be read as three words but as a single unit. Each unit should be picked up at

one pause or fixation."

No studies to date have shown that training to widen span has resulted in the ability to "see" in phrases during continuous reading. Feinberg's study, mentioned above, suggests that the physiological limitations of the eye will probably prevent the readers from ever accomplishing this goal. It is rather startling to note that despite the findings of over one hundred eye-movement studies, writers of reading improvement texts have persisted in this misconception. Perhaps they have done so because they know a person can "see" three or four words by staring at print or when words are flashed tachistoscopically.

This is possible because this seeing situation is static, and there is time to assimilate the less distinct impressions that occur in the periphery where visual acuity is reduced. This is in direct contrast to the situation that occurs during reading, in which image is superimposed on image at the rate of three to five per second. In addition, the demands of continually organizing the ideas presented in reading material are not present in such static situations. These conditions explain why the span of recognition as it occurs in reading is distinctly smaller than that occurring in static seeing situations (12).

9. Can the eye be trained to move down the center of a column of page of print, to make only a few fixations per page, permitting reading rates of thousands of words per minute? To answer this, one must first clarify what is meant by "reading." If one is referring to the act in which the reader contacts all of the words visually and strives for complete comprehension, reading rates of thousands of words per minute are impossible.

For even the most efficient readers, 800 w.p.m. is the practical limit for thorough and inclusive reading, based on the fact that few if any readers have displayed a span of over 2.7 words while simultaneously averaging more than 5 eye stops per second (2.7 words per eye stop X 5 stops per second X 60 seconds = 810 w.p.m.). This is not to say that people cannot be taught to skim and scan at apparent rates of thousands of words per minute, but skimming and scanning are distinctly different acts in which only part of the material is actually read, or dealt with, and in which comprehension is invariably reduced. Eye-movement photographs taken of persons involved in skimming and scanning show that only certain lines are read, and even those may not be read in total. In other words, skimming and scanning can be described as processes of looking and reading. The intermittent reading occurs resembles the person's usual reading performance.

Thus far, no photographs, even of proficient skimmers, have shown a person's eyes moving straight down the center of a column or page of print.

To summarize, eye movements are neither the cause nor the effect of good or poor reading. In other words, the eyes do not dictate to the mind what it shall understand, and neither does the mind dictate to the eyes where they shall look. Instead, there exists an interaction and interdependence between the oculo-motor activity and the central processes, each function indirectly influencing the other.

REFERENCES

1. Anderson, Irving H., "Studies in the Eye Movements of Good and Poor Readers," *Psychological Monographs*, *48* (1937), 1-35.

2. Ballantine, Francis A., "Age Changes in Measures of Eye Movements in Silent Reading," *Studies in the Psychology of Reading*. Monographs in Education, No. 4, Ann Arbor: University of Michigan Press, 1951, 67-111.

3. Buswell, Guy T., "Fundamental Reading Habits: A Study of Their Development," *Supplementary Educational Monographs*, No. 21. Chicago: University of Chicago Press, 1922.

4. Carmichael, Leonard and Walter F. Dearborn, *Reading and Visual Fatigue*. Boston: Houghton Mifflin Company, 1947.

5. Feinberg, Richard, "A Study of Some Aspects of Peripheral Visual Acuity," *American Journal of Optometry and Archives of American Academy of Optometry*, *62* (February-March, 1949), 1-23.

6. Gilbert, Luther C., "Functional Motor Efficiency of the Eyes and Its Relation to Reading," *University of California Publications in Education* Vol. II, No. 3. Berkeley, California: University of California Press, 1953, 159-231.

7. Letson, Charles T., "The Relative Influence of Material and Purpose on Reading Rates," *Journal of Educational Research*, *52* (February, 1959), 238-240.

8. McDonald, Arthur S., "Reading Flexibility: Its Meaning and Development," *EDL Research and Information Reprint No. 9*. Huntington, New York: Educational Developmental Laboratories, 1962.

9. Morse, William C., "A Comparison of the Eye Movements of Fifth and Seventh Grade Pupils Reading Materials of Corresponding Difficulty." *Studies in the Psychology of Reading*. Monographs in Education No. 4, Ann Arbor: University of Michigan Press, 1951, 3-64.

10. Seibert, Earl William, "Reading Reactions for Varied Types of Subject Matter," *Journal of Experimental Education*, 12 (Sept. 1942), 37-44.

11. Taylor, Earl A., *Controlled Reading*. Chicago: University of Chicago Press, 1937.

12. Taylor, Earl A., "The Spans: Perception, Apprehension, and Recognition," *American Journal of Ophthalmology*, *44* (October, 1957), 501-7.

13. Taylor, Stanford E., Helen Frackenpohl, and James L. Pettee, "A Report on Two Studies of the Validity of Eye Movement Photography as a Measurement of Reading Performance," *Reading in a Changing Society*, International Reading Association Conference Proceedings, Volume 2. New York: Scholastic Magazines, 1959, 240-45.

14. Taylor, Stanford E., Helen Frackenpohl, and James L. Pettee, *Grade Level Norms for the Components of the Fundamental Reading Skill*, EDL Research and Information Bulletin No. 3. Huntington, New York: Educational Developmental Laboratories, Inc., 1960.

15. Taylor, Stanford E., Helen Frackenpohl, Miriam Schleich, and others, *Controlled Reading Study Guide*. Huntington, New York: Educational Developmental Laboratories, Inc., 1963, 6.

16. Taylor, Stanford E., and H. Alan Robinson, "The Relationship of the Oculo-Motor Efficiency of the Beginning Reader to his Success in Learning to Read," a paper presented at the American Educational Research Association Conference, February 13-16, 1963.

17. Theophemia, Sister M., "Testing Flexibility in Reading," Challenge and Experiment in Reading. International Reading Association Conference Proceedings, Volume 7. New York: Scholastic Magazines, 1962, 138-9.

18. Thomas, E. Llewellyn, Remarks made during a panel discussion at the 44th Annual Education Conference at the University of Delaware, reported in Speed Reading: Practices and Procedures. Newark, Delaware: University of Delaware Reading-Study Center, 1963, 126-7.

MICRO-MOVEMENTS DURING APPARENT FIXATIONS IN READING

Donald E. P. Smith and Carl Semmelroth
University of Michigan

Saccadic eye movements, the ballistic motion and apparent stops or fixations during reading, have been studied extensively (1, 2, 3). Observation of the oral reading errors of problem readers led to the hypothesis that small, extremely rapid visual excursions to adjacent lines of print must occur during or between fixations resulting in the processing of extraneous letters and/or words. The Mackworth Optiscan camera (4) was modified to provide film records of the reading behaviors of normal and retarded readers.

The Optiscan consists of a miniature light source, a periscope, and a movie camera. Its purpose is to record the scene as viewed by the observer (O), along with a small eye position marker (spot of light) superimposed to indicate where O is looking (fixating) from moment to moment. The image of a miniature lamp is reflected from the cornea of the left eye into the periscope which then superimposes this marker onto the scene image. Thus the eye movements are recorded from the left eye, while only the right eye is "seeing".

Both head movement and displacement of the eye from a roughly constant rotational axis when moved produce distortion in the record. These were reduced by modifying the recording and analysis procedures. O sat in a specially constructed chair topped by a camera platform. The head was secured to a headrest and a bite-board provided a rest for the upper jaw while still allowing oral reading.

The visual display, a paragraph from an oral reading test (5), appeared on a screen at eye-level, 116" from O, and print size was equated to near-point reading. Prior to and following the reading, O fixated coordinates superimposed on the display. The locus of the coordinates of the finished film allowed determination of the amount and direction of error due to head movement. Since the task was brief, several records were made and those with least head movement selected for analysis. Distortion due to shifts in the rotational axes of the eye was reduced by using a small field (less than 6° of arc in radius) and by adjusting the size of the image on playback so that the distance between coordinates remained the same as in the display condition. Thus lateral distortion was minimized by using a small field and reduced further through counter-distortion in the analysis procedure.

A frame by frame analysis provided the results appearing in Figure 1. Line A is the record of a college student, reading at a high third grade level; line B is his record after perceptual training (6); line C is the record of a normal reader. Each circle has a latency of .07 seconds or less. Squares represent three or more frames too close together to allow differentiation. The following points are worthy of note:

1. Fixations in the traditional sense (latencies of .24 to .33 sec. (2,3)) consist of three or more micro-fixations. The slow speed of the camera (14 frames/sec.) makes latencies less than .07 difficult to detect. Exposure time of the film is about .03 sec. per frame. Movements within a .03 sec. interval are not observed except for an occasional light trace.

2. The amplitude of micro-movement within a letter ranges from 5 to 15 minutes of arc on the size of print used (the maximum visual angle subtended by an individual letter was 26 minutes of arc).

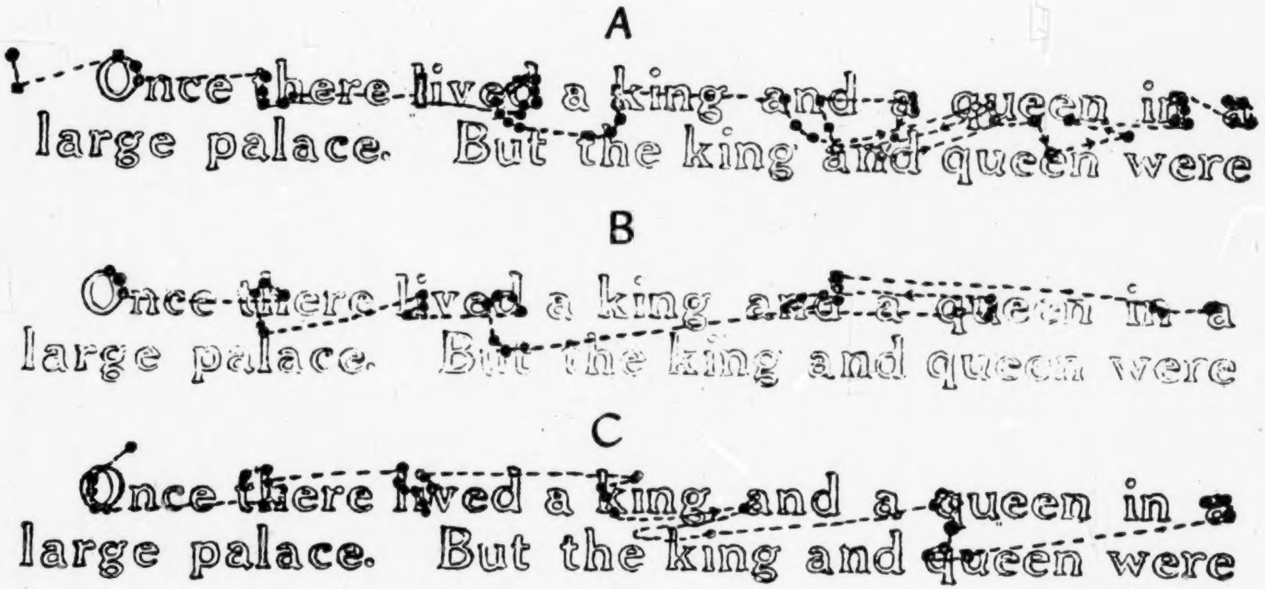

A
Once there lived a king and a queen in a
large palace. But the king and queen were
B
Once there lived a king and a queen in a
large palace. But the king and queen were
C
Once there lived a king and a queen in a
large palace. But the king and queen were

FIGURE 1.

Micro-movements of the eye during reading as recorded by a corneal reflection technique. Circles are of .07 sec. duration or less; squares indicate three or more circles. Lines A and B are the records of a college student with a reading disability, before and after perceptual training. Line C is the record of a normal reader. Stimulus material consisted of solid black letters on a white field; only outlines of letters are shown here.

3. Micro-movements during a fixation appear to follow gradients forming vertical straight contours and curved ones. (Stimuli consisted of black letters on a white field).

4. Excursions occur when a similar word, letter, or perhaps, identifying characteristic of a letter is adjacent to the fixated word (note and and queen).

5. After perceptual training, excursions continue to occur but with less frequency and shorter latency. Total time on line A is 7.0 sec., on line B, 2.45 sec.

6. Excursions of extremely brief latency occur also in the record of the normal reader (total time: 2.52 sec.).

To provide a more accurate analysis of a single letter perception, width of the field was reduced to 4° of arc in radius, and size of the print was increased by about 60%. Brightness of a point source of light was decreased and a faster film was used. The pattern was superimposed on the print with the result appearing in Figure 2. The following points are notable:

1. The amplitude of micro-movements within letters of this size ranges from 5 to 25 minutes of arc (maximum visual angle subtended by an individual letter was 39 minutes of arc).

2. Fixations tend to occur in the middle letters whereas, in Figure 1, they tend to occur on beginning and ending letters of words. This difference may be a function of the familiarity of the material.

3. Attack usually begins on the right side and midway in the letter (note no and

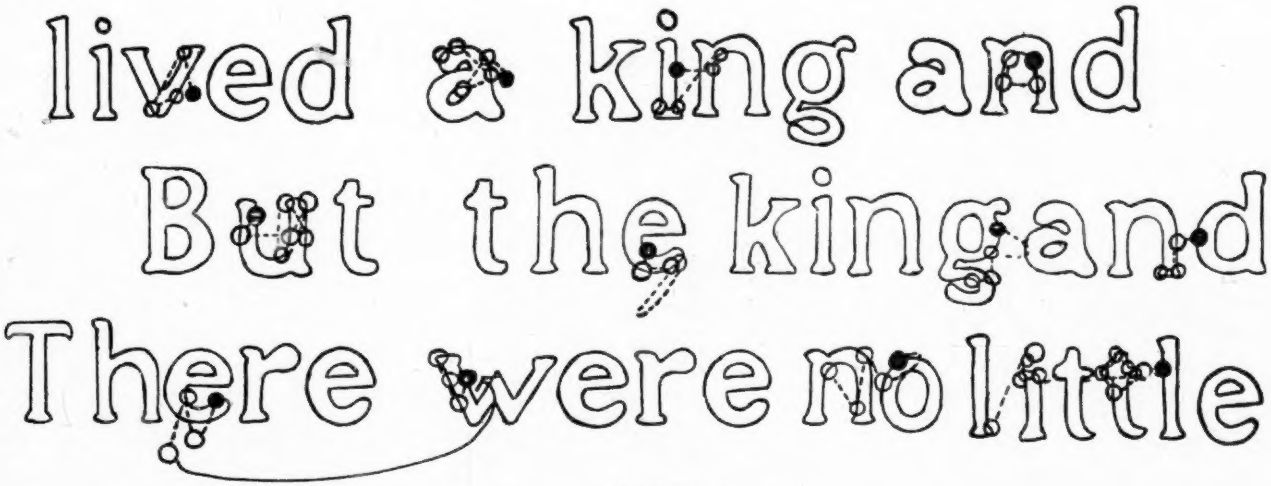

lived a king and
But the king and
There were no little

FIGURE 2.

Pattern of micro-fixations of a normal reader while reading familiar material. For clarity, dotted lines between groups of micro-fixations are not included. Filled circles are initial fixations; latencies are similar to those in Figure 1. Curved dotted lines represent excursions inferred from light traces on single frames of film.

little).

4. Movement follows the contours, with curves, verticals and terminals receiving equivalent attention. Note the excursion of the e of the.

5. While the accuracy of the record is limited, there appears to be an alternation between fixations on black-white gradients and white-black gradients (e.g., the right and left sides of a vertical.) The reproduction here shows only the outlines of the letters.

A possible relationship between the micro-movements observed during reading in this study and the slower "jerky" forms of physiological nystagmus should be considered. Ratliff and Riggs (2) reported motions with amplitudes between 1 and 5 minutes of arc occurring at the rate of 2-5 cycles per second during fixation of a small black dot.

They concluded that the shape of the fixation object had no effect on the nature of the physiological nystagmus in their study. However, their data was not obtained during an active perceptual search task such as reading.

REFERENCES

1. R. Dodge, Psychol. Bull., 2, 193-199 (1905).

2. C. H. Judd and G. T. Buswell, Suppl. Educ. Monogr. No. 23 (1922).

3. S. E. Taylor, Helen Frackenpohl and J. L. Pettee, E D L Research and Information Bulletin, No. 3, (Educational Developmental Laboratories, 1960).

4. N. H. Mackworth and E. L. Thomas, J. Optical Soc. Amer., 52, 713-716 (1962).

5. W. S. Gray, Oral Reading Paragraphs (Bobbs-Merrill, 1955).

6. R. R. Geake and D. E. P. Smith, Visual Tracking, (Ann Arbor Publishers, 1962).

7. F. Ratliff and L. A. Riggs, J. Exp. Psychol., 40, 687-701 (1950).